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РЕЗЮМЕ

ТАКСОНОМИЧЕСКИЙ КЛЮЧ ДЛЯ РАСПОЗНАВАНИЯ ВСХОДОВ СОРНЯКОВ НА ВОЗДЕЛЫВАЕМЫХ ПОЛЯХ

А. НЯРАДИ, Д. ПАЗМАНЬ

Благодаря сравнительному морфологическому изучению и с помощью почвенных биометрических данных о всходах сорняков, полученных опытной станцией в различных условиях внешней среды, разработан ключ для распознавания всходов сорняков в поле. Настоящий ключ не включает в себя паразитов и полупаразитов различных видов возделываемых растений, не включает ни луковичные и спорообразующие, ни многолетние виды, которые на возделываемых полях размножаются почти всегда вегетативным путем (например, *Sambucus ebulus*, *Phragmites communis*).

О ЖИЗНЕСПОСОБНОСТИ СПОР РАСЫ CLAVICEPS PURPUREA (FR.) TUL.

Т. ШОШ

Цель эксперимента заключалась в определении числа и энергии прорастания спор расы *Claviceps purpurea* после хранения их в течение 12 недель при комнатной температуре. Кроме того, изучали степень вирулентности расы, а также общее содержание алкалоидов, производимых спорыньёй в условиях полевого эксперимента.

Спустя 12 недель число конидиев уменьшалось менее, чем на 50%. Снижение энергии прорастания после такого срока хранения не было достоверным. Полевые опыты показали недостоверные различия по урожаю спорыньи, произвдимой отдельными расами, а количество спорыньи было удовлетворительным.

ПРИЗНАКИ ЗАБОЛЕВАНИЯ, ВЫЗВАННОГО РАЗЛИЧНЫМИ РАСАМИ КАРТОФЕЛЬНОГО ВИРУСА Y, У УСТОЙЧИВЫХ К PERONOSPORA TABACINA ADAM ВИДОВ NICOTIANA

Й. ХОРВАТ

Была испытана инфекционность 22-х выделенных групп картофельного вируса Y /(PVY) (*Marmor upsilon* Holmes), относящихся к четырем различным расам (раса С, PVY^{C}; нормальная раса, PVY^{N}; раса некроза жилок листа — Tabakrippenbräune — PVY^{R} и аномальная раса PVY^{An}). Показано, что виды *Nicotiana: Nicotiana Debneyi* Domin, *Nicotiana exigua* Wheeler, *Nicotiana goodspeedii* Wheeler, *Nicotiana megalosiphon* Heurck et Muell. и *Nicotiana tabacum* L. сорта «Resistant Hicks», устойчивые к *Peronospora tabacina* Adam (PtA), восприимчивы к PVY. Для дифференциации рас, особенно рас *Nicotiana debneyi* Domin. и *Nicotiana tabacum* L. сорта «Resistant Hicks», были выделены надёжные подопытные растения. Выделенные из *Nicotiana debneyi* Domin. расы PVY^{N} PVY^{An} вызывали у подопытных растений диффузную мозаику, деформацию листьев, задержку роста растений и курчавость листьев, тогда как расы $\mathrm{PVY}^{\mathrm{c}}$ и $\mathrm{PVY}^{\mathrm{N}}$ вызывали симптомы мозаики. Изоляты, относящиеся к расам $\mathrm{PVY}^{\mathrm{C}}$ и $\mathrm{PVY}^{\mathrm{N}}$, можно выделить из *Nicotiana tabacum* L. сорта «Resistant Hicks». Эти изоляты вызывали просветление и полосатость жилок листа, тогда как расы $\mathrm{PVY}^{\mathrm{R}}$ и $\mathrm{PVY}^{\mathrm{An}}$, кроме этого, вызывали ещё некроз жилок и стебля.

ВЫДЕЛЕНИЕ ЛЕТУЧЕГО МАСЛА ВЕНЧИКОМ РАЗВИВАЮЩИХСЯ ЦВЕТКОВ VALERIANA COLLINA WALLR.

Р. Г. СЕНТПЕТЭРИ, А. КОВАЧ, Ш. ШАРКАНЬ

В настоящей статье мы сообщаем о наших исследованиях летучего масла, выделяемого венчиком в стадии гамофилльной организации и постепенного созревания клеток. Летучее масло выделялось не только в клетки эпидермиса, но также в клетки мезофиллума и проникало сквозь клеточные стенки эпидермиса, покрытого кутикулой, во внешнюю среду без сколько-нибудь значительного осмоления. Наши исследования содержат также анатомическую характеристику эпидермиса.

ИНДУЦИРОВАННАЯ ПАРТЕНОКАРПИЯ У БАКЛАЖАН (SOLANUM MELONGENA L.)

Дь. ПАЛ, Е. ОЛАХ

В результате стимула, вызванного пыльцой, растущей в пестике баклажана, наблюдали развитие партенокарпических и нормальных (т. е. содержащих семена) плодов, различных размеров в разные годы, из изолированных и неизолированных, кастрированных и некастрированных цветков, в случаях, когда оплодотворение имело место или его не было. Если же пестик стимулировали искусственно, раздражая его, то развивались лишь партенокарпические плоды. Если пестик не стимулировали ни пыльцой, ни искусственно, то не развивались ни партенокарпические, ни нормальные плоды. Таким образом, явление партенокарпии у баклажан наследуется как предрасположение, а не как определенный признак. Наследственная склонность реализуется в результате действия на пестик различных стимуляторов и, таким образом, это явление представляет собою индуцированную партенокарпию.

ИССЛЕДОВАНИЕ ВИРУСА TNV, ВЫЗЫВАЮЩЕГО НЕКРОЗ ТАБАКА, ВЫДЕЛЕННОГО ИЗ ТЮЛЬПАНА

Р. ГАБОРЯНИ

Свойства десяти вирусов некроза табака TNV *(Marmor lethale* Holmes), выделенных первоначально из тюльпана, были изучены с целью установления их родства с вирусами, описанными до сих пор в Венгрии. В ходе экспериментов было установлено, что оба нормальных вируса TNV и вирус, вызывающий некроз жилок листа, заражали тюльпан одинаковым образом. Были удачно заражены такие виды и сорта растений, которые до сих пор ещё не внесены в список «хозяев» вируса TNV. Среди использованных подопытных растений *Phaseolus vulgaris* L. *Fürj* была наиболее пригодна для выделения штамма.

ДЕЙСТВИЕ ДИЕТИЧЕСКОГО ЖИРА НА ЭНЕРГИЮ И УСВОЕНИЕ БЕЛКА КРОЛИКАМИ

М. ТЕЛЕКИ, А. ДАРВИШ

Было широко изучено представление о влиянии добавленного в рацион растущих кроликов жира на переваривание и усвоение ими корма. Данные, полученные из этих исследований показали, что такой рацион улучшал коэфициент переваривания корма, тый день практически ни в одном из вариантов не было завязывания. Пестик исследованного сорта К. Е—15 достигал начала половой зрелости тогда, когда бутон имел размер 3 мм. На основании результатов ежедневного опыления, начиная с этой стадии развития, способность пестика к оплодотворению возрастала. Оптимум оплодотворения был получен тогда, когда опыление производилось пыльцой, собранной в день растрескивания пыльников или на день позже. В том случае, когда отсутствовала своя пыльца, получили более высокий процент завязывания гибридных семян, чем без кастрации.

В зависимости от года, эффективное опыление у исследованных сортов можно проводить на 4—5 день после кастрации, проделанной в фазе белого бутона.

О НЕКОТОРЫХ ФИТОПАТОЛОГИЧЕСКИХ ВОПРОСАХ И УСТОЙЧИВОСТИ ИНДУЦИРОВАННОГО МУТАНТА ЯЧМЕНЯ К ШВЕДСКОЙ МУХЕ

Е. ПОЛХАМЕР

В течение нескольких лет изучали устойчивость ярового ячменя сорта MFB 104 к ложно-мучнистой росе и головне, применяя искусственное заражение, и устойчивость к полосатости листьев и шведской мухе при естественном заражении. Амплитуда изменения четырех названных признаков среди общего числа мутантов была выше, чем у исходного сорта. 0,25% мутантов были совершенно устойчивы к ложно-мучнистой росе и поэтому могут служить исходным материалом для скрещивания. Мутанты с колеблющейся устойчивостью для этих целей не пригодны. Мутант r 483/7, устойчивый к ложно-мучнистой росе, по выраженности других своих благоприятных признаков также может быть практически ценным. Не обнаружены мутанты, устойчивые к головне, полосатости листьев и шведской мухе. Некоторые мутанты, благодаря своей устойчивости, могут быть использованы как генетический материал.

ПАРТЕНОКАРПИЧЕСКОЕ ЗАВЯЗЫВАНИЕ ПЛОДОВ МОРЕЛИ СОРТА «PÁNDY», ВЫЗВАННОЕ ОБРАБОТКОЙ ГИББЕРЕЛЛОВОЙ КИСЛОТОЙ АУКСИНОМ И ССС

Й. М. ЗАТЬКО

Опрыскивая самонесовместимую морель сорта «Pándy» смесью 2,4—Д и гибберелловой кислоты, получили урожай партенокарпических плодов, определённая часть которых (20—23%) была удовлетворительной даже по своей рентабельности. С другой стороны, при опрыскивании лишь 2,4—Д эффективность была незначительной, а при опрыскивании одной лишь гибберелловой кислотой—практически неэффективной. Индолуксусная кислота ускоряла опадение цветков и недоразвившихся плодов в том случае, когда её использовали одну или вместе с гиберелловой кислотой. ССС [2-хлорэтил-(триметиламмоний)хлорид] вёл себя индифферентно во всех комбинациях.

Хотя морель «Pándy» является самонесовместимой, тем не менее кастрация значительно уменьшала процент завязывания плодов в сравнении с обработкой, когда применялась только изоляция.

Так как гибберелловая кислота очень дорогая, результаты этих экспериментов имеют лишь теоретическое значение. Кроме того, необходимо подчеркнуть, что размер партенокарпических плодов не достигает размеров плодов, полученных в результате оплодотворения, хотя заметная часть этих плодов представляет экономическую ценность.

ПОДКОРМКА ПАСТБИЩ МИКРОЭЛЕМЕНТАМИ

Е. ХАРАСТИ, Г. ТЁЛДЕШИ

Изучено действие микроэлементов на урожай и минеральный состав растений. Установлено, что в условиях Венгрии внесение одних лишь микроэлементов может повысить урожай пастбищ, хотя и в умеренных пределах. Питательная ценность, минеральный состав второго укоса изменились лишь незначительно. Удобрения типа N и NPK на 27% увеличивали накопление меди в растениях. Автор предполагает, что цинковое удобрение и марганец, снижающие действие бора, по своему действию могут быть классифицированы как явление синергизма и антагонизма ионов.

ХАРАКТЕРИСТИКА НЕКОТОРЫХ ПАРАМЕТРОВ ПЕРЕДВИЖЕНИЯ ИОНОВ И ТРАНСЛОКАЦИЯ

I. Влияние изоляции и предварительной обработки на передвижение бромида

З. БЁСЁРМЕНИ, Е. ЧЕХ, Г. МЕСЕШ

В опыте изучалось влияние предварительной обработки одинаковыми ионами проростков пшеницы и срезанных корешков на параметры поступления и утечки бромида. Предварительная обработка особенно снижает V_{max} процесса поступления, который насыщается при низкой концентрации. Действие предварительной обработки можно заметить уже в течение двух часов, период примерно в 10—12 часов необходим для развития его максимума. У срезанных корешков выявление эффекта предварительной обработки осложняется влиянием других факторов, вызванных самой изоляцией корешков. Вследствие этого поступление бромида в срезанных корнях повышается как в растворе $CaSO_4$, так и в растворе $CaSO_4$, содержащем ионы бромида, но у последнего в меньшей степени. Предварительная обработка скорее снижает, чем увеличивает утечку бромида срезанными корнями. Учет действия предварительной обработки и изоляции необходим при сравнении параметров передвижения ионов у различных видов и сортов.

ДИФФЕРЕНЦИАЦИЯ РОДОВ AGROBACTERIUM И ВИДОВ RHIZOBIUM СИНТЕТИЧЕСКИМИ КРАСИТЕЛЯМИ

Я. А. ХАМДИ

Четыре синтетических красителя, — малахитовая зеленая, бриллиантовая зеленая, пиронин и тионин, — были прибавлены к общепринятой среде агар—79, агару и мясному бульону,. использовавшимся как основные среды в концентрации 320, 80 и 20 ppm. По 15 штаммов от *R. meliloti*, *R. trifolii*, *R. leguminosarum*, *R. japonicum*, ризобий коровьего гороха, *R. lupini* и *A. radiobacter*, 12 штаммов *A. tumefaciens* и 18 штаммов Rhizobium были нанесены в виде мазков на агар с красителем и культивированы на содержащем краситель мясном бульоне. Что касается концентрации 80 ppm красителя в агаре, штаммы агробактерии и *R. meliloti* показали высокую устойчивость к каждому из четырех красителей. *R. trifolii*, *R. leguminosarum* и *R. phaseoli* показали низкую, промежуточную или высокую устойчивость к пиронину и тионину соответственно; все штаммы показали низкую устойчивость к малахитовой зеленой. *R. Japonicum* ризобий коровьего гороха и *R. lupini* были чувствительны к малахитовой зеленой, бриллиантовой зеленой и тионину.

ДЕЙСТВИЕ СКАШИВАНИЯ НА РЯД ПРИЗНАКОВ РАЙГРАССА (LOLIUM MULTIFLORUM VAR. WESTERWOLDICUM LAM.) ПРИ ВЫРАЩИВАНИИ В ПОЛЕВЫХ УСЛОВИЯХ

А. А. ЭЛЬ-МОУРЗИ, А. РААФАТ, С. Х. ЭЛЬ-ГАЯТИ

Опыт был выполнен на экспериментальной ферме сельскохозяйственного факультета в Гизе, О. А. Р. с целью выявить эффект скашивания на рост райграсса *(Lolium multiflorum* var. *westerwoldicum* Lam.) при выращивании его одного в полевых условиях. Скашивание до 3-х дюймов было произведено, когда растения достигли высоты около 80 см. Результаты показывают, что скашивание обычно уменьшает высоту растения, количество побегов и листьев, а также площадь листьев растения. Это показывает, что данная трава очень чувствительна к скашиванию, в случае когда выращивается одна в полевых условиях.

ЕЙСТВИЕ ДЕФИЦИТА КАЛЬЦИЯ И СЕРЫ НА УРОВЕНЬ ДНК И РНК В РАЗЛИЧНЫХ ЧАСТЯХ LINUM USITATISSIMUM L.

Р. К. СРИВАСТАВА, Ш. РАНЬЯН

Изучалось действие дефицита кальция и серы на уровень ДНК и РНК в различных частях *L. usitatissimum*. Растения были выращены на кислотой промытом кремнистом песке. Оба ДНК и РНК уменьшились при дефиците кальция и серы растений.

исключая случаи эфирного экстрагирования и грубого волокна. Увеличивая добавление жира, наблюдали ещё более лучший коэффициент переваривания пищи.

Добавление жира в рацион уменьшало дыхательный коэфициент кроликов.

Имеется взаимозависимость между энергией поглощения и сохранением энергии в теле. Частично энергия уходит на дыхание. Таким же образом количество тепла уменьшается, когда энергия поглощения возрастает. В противоположность этому процентное убывание энергии в кал увеличивалось незначительно с повышением энергии поглощения.

Несмотря на то, что на запасной белок не действовало добавление в рацион жира, содержанке запаса последнего тем не менее возрастало.

НОВАЯ, СПОРАДИЧЕСКИ ПОЯВЛЯЮЩАЯСЯ БОЛЕЗНЬ САХАРНОЙ СВЕКЛЫ BETA VULGARIS VAR. SACCHARIFERA (L.) ALEFELD, ВЫЗВАННАЯ ДЕЙСТВИЕМ МИКРОЭЛЕМЕНТОВ ПОЧВЫ, И ПРЕДВАРИТЕЛЬНОЕ ИЗУЧЕНИЕ ЕЁ С ПОМОЩЬЮ ДОЗИМЕТРИЧЕСКОГО И РАДИОГРАФИЧЕСКОГО МЕТОДОВ

Ф. ПЭШЭК

В настоящей статье рассматривается вопрос о недавно обнаруженной с помощью радиометрических методов физиологической болезни сахарной свеклы *Beta vulgaris* var. *saccharifera* (L.) **Alefeld**. Эта болезнь спорадически появляется в Чехословакии вблизи **Kutná Hora**, в городах вдоль водных каналов для сточных вод, расположенных в средневековых рудниках. Болезнь снижает количество урожая корней сахарной свеклы на 49,02%, а содержание сахара на 37,70%; её охарактеризовали по признакам габитуса и по гипоплазматическим морфозам. Симптомами болезни служили различные нарушения, некрозы, морфозы, протоплазматические расстройства и открытые некротические поражения тканей. В соответствии с условиями опытного участка, болезнь вызывалась действием радиоактивных элементов K, Ca, Sn, Fe, Zn, Sr, Cd, Cr, которые вместе с другими элементами: Mg, Mn, As, Na, Ti, Ag, Cu, Pb, B были найдены в сорбционном комплексе данной почвы. Здоровые растения извлекают из почвы относительно больше калия, чем больные растения, и равномерно распределяют в корнеплодах природные радиоактивные элементы. На основании других данных, больные растения получают из почвы относительно меньше калия и распределяют естественные радиоактивные элементы K, Ca, Sn, Fe, Zn, Sr, Cd, Cr в центрах диффузии отдельными островками или по типу мозаики. Ход патологического процесса на последней фазе болезни приводит к механическому закупориванию сосудистых элементов (трахеид) корнеплода. Накопление метаплазматических веществ распада в клетках корня вызывало плазмохизис и гранулёзис. У больных растений удельная активность сухого вещества в корнеплодах доходила до $5{,}4 \times 10^{-11}$ с грамм/%, а в листьях до $2{,}6 \times 10^{-11}$с. У здоровых растений соответствующие данные составляли $2{,}5 \times 10^{-11}$с. и $2{,}3 \times 10^{11}$с.

Топографическое распределение естественных радиоактивных элементов в больных растениях отличается от распределения этих элементов в здоровых растениях.

ИЗУЧЕНИЕ ОСТРЫХ ВЕЩЕСТВ ПЛОДОВ CAPSICUM ANNUUM L. И НЕКОТОРЫХ ДРУГИХ ВИДОВ РОДА CAPSICUM GENUS

К. ЮХАС, Э. ТИХАК

Капсаицин, который придает плодам *Capsicum annuum* L. острый вкус, недавно был разделён на два компонента (**Kosuge** *et al.* 1958). Количественное и качественное изменение этих двух компонентов в плодах разных сортов, относящихся к формам *Capsicum annuum* L., и эти изменения у других видов рода *Capsicum* были изучены с помощью тонкослойной хроматографии на двух стадиях развития плодов. Установлено, что в плодах, всех изученных нами острых сортов и видов, капсаицин *а* и капсаицин *б* присутствуют совместно. Обычно капсаицин *а* присутствует в плодах в большем количестве, чем капсаицин *б*.

ДЕЙСТВИЕ НИЗКОЙ ТЕМПЕРАТУРЫ НА ПОГЛОЩЕНИЕ ИОНОВ КОРНЯМИ РИСА

Ф. ЖОЛДОШ

Был проделан небольшой эксперимент с отрезанными корнями риса. Обнаружены различия в поглощении ионов при снижении температуры. В то время, как поглощение фосфатов и бромидов при снижении температуры уменьшалось в каждом отдельном случае, поглощение рубидия при температуре ниже 8° С начинало возрастать. Предполагается, что шок, вызванный действием холода (внезапное изменение температуры), является причиной этого необычного результата. Степень выраженности этого эффекта можно снизить, применяя постепенное охлаждение. Непродолжительное влияние холода не приводит к необратимым физиологическим изменениям интактных растений, но спустя три дня можно было наблюдать нарушение роста корней и ростков.

ОНЕКОТОРЫХ АСПЕКТАХ ГИБРИДИЗАЦИИ TRITICUM С AGROPYRON И SECALE

А. ПРИАДЧЕНКУ

В результате простого скрещивания *Triticum с Agropyron intermedium* II. нами в F_2—F_4 получены многолетние растения, большинство из которых давало два урожая в год. Эти потомства послужили основным материалом для кормовых злаков. Сложное скрещивание может дать гибриды однолетнего типа, высоко устойчивые к поражению ржавчиной. Это было доказано путем искусственного заражения бурой ржавчиной и в результате проверки устойчивости к жёлтой ржавчине в естественных условиях.

Сложное скрещивание гибрида *Triticum* × *Secale*, проведенное с местными формами *Triticale* также дало устойчивые к ржавчине потомства, которые рано созревали и были полностью фертильными. Вместе с идентификацией новых амфидиплоидных форм был также создан богатый селекционный материал.

Гибриды пшеницы × *Secale* при скрещивании их с культурными амфидиплоидами дали богатый селекционный материал, который может служить основой для индентификации амфидиплоидных форм и в дальнейшем.

ДАННЫЕ О ЕЖЕДНЕВНОМ РИТМЕ НЕКОТОРЫХ ЖИЗНЕННЫХ ПРОЦЕССОВ И ПОВЕДЕНИИ ТЕЛЯТ

Й. ЦАКО, Г. БАРЦИ, Ш. БАЛИКА

Авторами были изучены поведение и ежедневный ритм главных жизненных процессов 6—18-недельных телят. Установлено, что, вследствие взаимного надоедания и менее продолжительного периода в лежачем положении, телят надо держать в телятнике менее продолжительное время. Разумным доводом в пользу этого соображения были данные о взаимном влиянии телят друг на друга при совместном содержании. По сравнению с лежачим положением, время жвачки в стоячем положении возростало, в результате чего у телят, которые содержались в телятнике, изменялся характер жвачки. Время и частота поедания сена телятами в помещени были достоверно выше, чем при раздельном содержании их, потому что телята подражали друг другу и привыкали есть быстрее.

КОРРЕЛЯЦИЯ МЕЖДУ ВОЗРАСТОМ ПЕСТИКА КРАСНОГО ПЕРЦА И ЕГО ОПЛОДОТВОРЕНИЕМ

Ф. МАРКУШ

В ходе экспериментов изучена корреляция между возрастом пестика красного перца и его оплодотворением, применяя опыление на разных стадиях развития бутона. В конкретных условиях пестик сохранял свою жизнеспособность (жизненный потенциал) и на 5-ый день в каждом исследованном варианте, предполагая, что опыление было выполнено в так называемой фазе белого бутона; при этом результат был даже лучше, чем при опылении в день кастрации. Оптимальное завязывание плодов и число семян на плод было в том случае, когда опыление производили на третий день после кастрации. На девя-

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TAXONOMIC KEY FOR THE IDENTIFICATION OF WEED SEEDLINGS IN CULTIVATED FIELDS

By

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Through comparative morphological studies and on the ground of biometrical data of weed seedlings supplied by experimental stations with varying environmental conditions there has been developed a key for identifying weed seedlings in the field.[1] The present key includes no parasite and semiparasite species in the crops, neither the bulbiphere and sporiphere, nor the perennial species that, in cultivated fields, reproduce almost exclusively in vegetative way (e.g. *Sambucus ebulus*, *Phragmites communis*).

Introduction

In the literature the description of weed seedlings is almost completely missing and no taxonomic key is available that may contribute to the identification of approximately 150 weed species at an early developmental stage which are rather frequent in cultivated fields of Central Europe. This fact makes more difficult to point out precisely in due time the frequency and floristic composition of weeds in the field. The identification of the weeds should precede the application of herbicides, right after the weed plant sprouted.

Material and Method

The taxonomic key has been set up in the usual way, i.e. by grouping the distinctive characters into theses (a) and antitheses (b). The distinctive characters are referred to the most important vegetative organs at this age (seed lobes, leaves, stems, hairs, etc.). All these characteristics can be relatively easily identified in the plantules being at the 1—6 leave-bearing age. Sometimes a magnifying glass is needed to identify the type of hairiness, which case is hereinafter indicated by ± !.

Each described species has figure of its own, usually diminished and for the evidence of the hairiness certain details of the figures are many times magnified.[2]

It is to be mentioned that the numeration of species in the key corresponds to the number indicating to the figure of the plantules in the iconography. In cases when the species appears in two different places of the key, the species and the figure have identical number in both places.

The key deals with 151 weed species which are common in plant communities of the orders *Secalinetalia* Br.-Bl. and *Chenopodietalia* Br.-Bl., and belong to 106 genera and 32 fami-

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[1] The data referring to the comparative morphology of the weed seedlings are included in part in our work "Contributions to comparative morphological study of weed seedlings on the land". (Lucrarile stiintifice ale Institutului Agronomic "Dr. Petru Groza" Cluj, *XVI*, 5—20.)

[2] L. Cimpianu and E. Szapita designed the figures 1—151 from nature.

lies. These species in the flora of our country are archeophyte, apophyte and neophyte. They are wide-spread not only in Rumania, but also in most of the European countries and even in other continents. Thus 26.5 per cent of the species is considered cosmopolitan weed, 29.8 per cent is frequent in Europe, W—SW Asia; 30.5 per cent grows in Eurasia and North America, while 13.2 per cent can be found only in European countries. Most of these species are monocarpic plants, i.e. annuals and biennials (84 per cent and 2 per cent, respectively). The policarpic perennial plants are less in number, i.e. 14 per cent only.

Results

Taxonomic key

1 a Plantule without seed lobes above the earth *(cotyledones hypogaeae);* leaves simple, linear, usually with cylindric ± long sheath, or pinnately compound leaves, without sheath, with integral or toothed leaflet 2

1 b Plantule with 2 seed lobes above the earth *(cotyledones epigaeae);* leaves simple or compound, without cylindric sheath 23

2 a Leaves with cylindric sheath, unpetiolate, with linear blade; marked, membranous coleoptile; roots close-clustered, without knottiness 3

2 b Leaves without cylindric sheath, unpetiolate or often petiolate, with undivided blade, simple or compound of leaflets; the coleoptile is missing; under the first leaf on the nodes some membranous scales *(cataphylla);* radicular system with marked main root; radicles with knottiness 13

3 a Plantule 5—6 foliated, at base with fruit still persistent, big, dorsal long-awned and markedly bristly-pilose; leaves with usually distantly ciliate blade (Pl. I, Fig. 1 and 1 a)

1. **Avena fatua** L.

3 b Plantule 5—6 foliated, at base with the fruit rarely persistent, without marked dorsal awn, and of different shape 4

4 a Surface of the sheath pilose; hairiness more evident sometimes only at its base 5

4 b Surface of the sheath unpilose, sometimes long-ciliate on the superior part only on margins 9

5 a Ligula marked, membranous or reduced to a small hair-coronet .. 6

5 b No ligula; sheath towards the base markedly densely pilose; blade glabrous or glabrescent (Pl. I, Fig. 2 and 2 a)

2. **Echinochloa crus-galli** (L.) P. Beauv.

6 a Ligula marked, membranous 7

6 b Ligula reduced to a small hair-coronet (Pl. I, Fig. 3, 3 a and 3 b)

3. **Setaria verticillata** (L.) P. Beauv.

7 a Sheath and foliar blade distantly long haired, or with minute dense hairs **8**

7 b Sheath and foliar blade densely spreading-pilose, with white thin ± long hairs (Pl. I, Fig. 4 and 4 a)

4. **Digitaria sanguinalis** (L.) Scop.

8 a Face of the blade with minute rigid hairs (!), blade smoothed from the apex towards the base appears scabrous (Pl. I, Fig. 5 and 5 a)

5. **Agropyron repens** (L.) P. Beauv.

8 b Face of the blade with long hairs or glabrescent, not scabrous (Pl. I, Fig. 6 and 6 a)

6. **Bromus secalinus** L.

9 a Ligula marked membranous; margin often ± laciniate, without hair **10**

9 b Ligula is missing or usually reduced to a coronet of short hairs; base of the blade or margin of the sheath with long hairs **12**

10 a Blade with very minute, rigid hairs (!) smoothed from the apex towards the base appears scabrous (Pl. I, Fig. 5 and 5 a)

(5) **Agropyron repens** (L.) P. Beauv.

10 b Blade with longer, remote hairs, or glabrescent, it is not scabrous **11**

11 a First 2—3 leaves are wider than 2 mm, the next ones even wider (Pl. I, Fig. 6 and 6 a)

(6) **Bromus secalinus** L.

11 b First 2—3 leaves 1 mm wide at most, the next ones wide about 2 mm (Pl. I, Fig. 7)

7. **Apera spica-venti** (L.) P. Beauv.

12 a Base of blade (above the ligula) with some thin very long (—5 mm) white hairs; margin of sheath at superior part glabrous (Pl. I, Fig. 8)

8. **Setaria glauca** (L.) P. Beauv.

12 b Base of blade (above the ligula) without hair, the margin of sheath at the superior part with white hairs (—2 mm) (Pl. I, Fig. 9)

9. **Setaria viridis** (L.) P. Beauv.

13 a (from 2 b) Leaves sessile, simple, integral, linearly lanceolate or linear. acute; the 5—6 leaves are wide of 2—3 mm and long of 2—4 cm or longer (Pl. II, Fig. 10)

10. **Lathyrus nissolia** L.

13 b Leaves petiolate, pinnately compound; at least the first 1—2 leaves with 2 or more leaflets **14**

14 a Only the first 2 (3) leaves with 2 leaflets, the next ones transformed into tendrils, without leaflets, only with 2 relatively big green ± triangular stipules (Pl. II, Fig. 11)

11. **Lathyrus aphaca** L.

14 b All the leaves foliated; superior ones with rachis ending in bristle or tendril **15**

15 a Stipules large, usually wide of 5—6 mm, or even wider, ovate elliptical, with apex acute ± awned and with base rounded, toothed; leaflets widely ovate elliptical, nearly orbicular or widely obovate, wide at least of 1 cm (Pl. II, Fig. 12)

12. **Pisum arvense** L.

15 b Stipules small, much more narrow than 5 mm, narrowly triangular or setiform reduced; narrower leaflets, sometimes of only 2—3 mm **16**

16 a Stipules of 3—6 leaves longer than the half length of the petiole, or ± as the half of that one **17**

16 b Stipules of the leaves 3—6 markedly shorter than the half length of the petiole **18**

17 a At least the first (1—3) leaves with the margin of the leaflets finely uniformly and minutely toothed (!) (Pl. II, Fig. 13 and 13 a)

13. **Lathyrus hirsutus** L.

17 b Margin of leaflets not toothed (Pl. II, Fig. 14)

14. **Lathyrus tuberosus** L.

18 a First 3 (4) leaves, with 2 leaflets **19**

18 b Second and next leaves at least with 4 or more leaflets **21**

19 a First leaves with linear leaflets, long of 25—30 mm and wide of 2—2.5 mm, those of the basal branches wider, of different shape (Pl. II, Fig. 15)

15. **Vicia sativa** L.

19 b First leaves with leaflets shorter than 20 mm **20**

20 a Leaflets lanceolate or linear lanceolate, acute, mildly narrowed towards the apex, usually longer than 10 mm (Pl. III, Fig. 16)

16. **Vicia angustifolia** Grufb. in L.

20 b Leaflets elliptical, abruptly narrowed and rounded at apex, usually shorter than 10 mm (Pl. III, Fig. 17)

17. **Vicia tetrasperma** (L.) Schreb.

21 a Leaflets short, small, widely elliptical, long only of 4 (5) mm and wide of 2 mm (Pl. III, Fig. 18)

18. **Vicia hirsuta** (L.) S. F. Gray

21 b Leaflets lengthened, lanceolate, longer than 5 mm **22**

22 a The last not markedly developed leaf is long white pilose (!) (Pl. III, Fig. 19 and 19 a)

19. **Vicia villosa** Roth

22 b The last leaf not developed yet, glabrous or subglabrous (Pl. III, Fig. 20)

20. **Vicia pannonica** Cr.

23 a (from 1 b) Leaves all simple, with blade undivided, integral on the margins, exceptional (beginning with the third leaf) the blade ± sinuous or toothed **24**

23 b Leaves all compound or simple but with the blade markedly palmate or pinnately divided, sometimes only sinuous or toothed; exceptional first 1—2 leaves simple and entire, but the next ones markedly divided or compound **84**

24 a Leaves whorled, disposed by 4—6 or more on remote nodes **25**

24 b Leaves alternate or opposite 2 by 2, disposed on remote or very near nodes, forming a rosette **29**

25 a Seed lobes linear filiform, long of 2—3 cm and wide of about 1 mm; leaves of the whorls as wide as the seed lobes (Pl. IV, Fig. 21)

21. **Spergula arvensis** L.

25 b Seed lobes wide, relatively large; leaves of the whorl are of other dimensions than the seed lobes **26**

26 a Blade of seed lobes elliptical, about twice longer than wide or even longer; plantule with scabrous, minute, rigid hairs, disposed downwards (Pl. IV, Fig. 22 and 22 a), (syn. *Galium tricornutum* Dandy)

22. **Galium tricorne** Stokes

26 b Blade of seed lobes as long as wide or a bit longer **27**
27 a Whorls 1—3 always with 4 leaves (Pl. IV, Fig. 23)

23. **Sherardia arvensis** L.

27 b Whorls (1) 2—3 and the next ones with 5 or more leaves **28**
28 a First internodes with angles markedly scabrous, shortly pilose, with rigid hairs disposed with the apex towards the base of the internode (Pl. IV, Fig. 24 and 24 a)

24. **Galium aparine** L.

28 b First (1—3) internodes with glabrous angles (Pl. IV, Fig. 25)

25. **Asperula arvensis** L.

29 a Base of foliar blade arrow-shaped, hastate, hastate-heart shaped or truncate **30**
29 b Base of foliar blade cuneate, rounded, abruptly or mildly tapered into petiole **33**
30 a Nodes of stem with membrous ochrea **31**
30 b Nodes of stem without ochrea **32**
31 a First leaves clustered into rosette; blade hastate lengthened lanceolate; ochreas well developed (Pl. V, Fig. 26)

26. **Rumex acetosella** L.

31 b First leaves alternate on remote nodes; blade triangular, ± arrow-shaped, ochreas short (Pl. V, Fig. 27 and 27 a) (syn. *Bilderdykia convolvulus* (L.) Dumort.)

27. **Fagopyrum convolvulus** (L.) H. Gross

32 a Seed lobes widely elliptical, ± rectangular, towards the apex or at the middle wider; foliar blade with basic lobes usually acute (Pl. V, Fig. 28)

28. **Convolvulus arvensis** L.

32 b Seed lobes widely ovate, wider towards the base; foliar blade with basic lobes truncate, rounded or obtuse (Pl. V, Fig. 29)

29. **Calystegia sepium** (L.) R. Br

33 a Nodes of the stem with membranous ochreas **34**
33 b Nodes of the stem without ochreas **37**
34 a Petiole in the middle or above the middle of the ochrea (Pl. V, Fig. 30) (syn. *Persicaria amphibia* (L.) S. F. Gray)

30. **Polygonum amphibium** L. var. **terrestre** Leyss.

34 b Petiole at the base of the ochrea **35**

35 a Superior margin of the ochrea entirely or roughly incised, sometimes very minutely ciliate (!) (Pl. V, Fig. 31) (syn. *Persicaria lapathifolia* (L.) S. F. Gray)

31. **Polygonum lapathifolium** L.

35 b Superior margin of the ochrea deeply incised or ± entire and long ciliate **36**

36 a Surface of the ochrea minutely appressed bristly-pilose (!), margin ± entire, longly ciliate (Pl. V, Fig. 32 and 32 a) (syn. *Persicaria vulgaris* Webb. et Moqu.)

32. **Polygonum persicaria** L.

36 b Surface of the ochrea glabrous, margin usually deeply laciniate, unciliate (Pl. V, Fig. 33 and 33 a)

33. **Polygonum aviculare** L.

37 a Seed lobes markedly hairy; sometimes only the surface, margin of the blades or petiole (particularly towards the base) hairy **38**

37 b Seed lobes completely glabrous **47**

38 a Seed lobes and first leaves only with simple hairs **39**

38 b Seed lobes and first leaves only with branching hairs or mixed with simple hairs **45**

39 a Plantule 2—3 foliated with seed lobes wider than 1 cm, elliptic or nearly round **40**

39 b Plantule 2—3 foliated with seed lobes much narrower or at most 1 cm wide **41**

40 a Seed lobes with blade shortly pilose on both sides; blade margin of the first leaves with short hairs mixed with longer ones (Pl. VI, Fig. 34, 34 a and 34 b)

34. **Symphytum officinale** L.

40 b Seed lobes with pilose blade only on front side; blade margin of the first leaves only with short hairs (Pl. VI, Fig. 35, 35 a and 35 b)

35. **Cynoglossum officinale** L.

41 a Hypocotyl and epicotyl with dense or rare hairiness (!) **42**

41 b Hypocotyl, often even epicotyl glabrous; foliar blade elliptic or obovate, at base ± asymmetrical abruptly narrowed into petiole; seed lobes with blade shorter than 1 cm (Pl. VI, Fig. 36)

36. **Myosotis arvensis** (L.) Hill.

42 a Foliar blade on both sides with rigid, minute, dense, appressed, rigid (!) hairs **43**

42 b Foliar blade glabrous on front side, only margin, base and petiole with spreading hairs (!) **44**

43 a Foliar blade ovate, at most 15 mm long; seed lobes with blade long till 5 mm (Pl. VI, Fig. 37, 37 a and 37 b)

37. **Heliotropium europaeum** L.

43 b Foliar blade narrow inversely lanceolate, longly tapered into petiole, longer than 20 mm; seed lobes with blade longer than 10 mm (Pl. VI, Fig. 38)

38. **Lithospermum arvense** L.

44 a Seed lobes with blunt blade (Pl. VI, Fig. 39)

39. **Kickxia spuria** (L.) Dum.

44 b Seed lobes with acute blade (Pl. VI, Fig. 40)

40. **Solanum nigrum** L.

45 a Leaves 4—6 with hairs branching and simple; branching ones with pedicel, bi- or trifurcate, disposed especially on the margin of the blade, simple ones disposed especially on the petiole and on the surface of the blade; seed lobes hairly only at base of the petiole (Pl. VI, Fig. 41 and 41 a)

41. **Camelina microcarpa** Andrz.

45 b Leaves 4—6 only with branching (stellate) hairs **46**

46 a Hairs stellate usually with 10—12 or more branches (Pl. VI, Fig. 42 and 42 a) (syn. *Alyssum calycinum* L.)

42. **Alyssum alyssoides** (L.) Nath.

46 b Hairs bi- or trifurcate; bifurcate ones appressed, disposed particularly on the petiole and internodes, trifurcate ones disposed particularly on the foliar blade and seed lobes. Seed lobes small, narrowly elliptic; beginning with the (3th) 4th leaf the blade inversely lanceolate with few remote teeth (Pl. VI, Fig. 43, 43 a and 43 b)

43. **Erysimum repandum** Höjer

47 a (from 37 b) At least the first 1—2 nodes with opposite leaves marked internodes **48**

47 b All the nodes with alternate leaves; internodes marked or very short, with leaves clustered into rosette **65**

48 a Leaves sessile, not petiolate **49**
48 b Leaves petiolate; petiole marked, sometimes very short **52**
49 a Leaves with blade ovate or elliptic, on the back usually with remote, brown (!) points (Pl. VII, Fig. 44 and 44 a)

44. **Anagallis arvensis** L.

49 b Leaves with blade lanceolate, linear lanceolate or awl-shaped, sometimes nearly filiform **50**
50 a Leaves linear awl-shaped or ± filiform, wide of about 1 mm and long at most of 1 cm, base of the opposite leaves ± vaginate; internodes usually short; seed lobes linear ± as wide as the leaves (Pl. VII, Fig. 45 and 45 a)

45. **Scleranthus annuus** L.

50 b Leaves inversely lanceolate, lanceolate or linear lanceolate, much wider than 1 cm and some cm long; seed lobes elliptic or lanceolate, wide of 3—10 mm and long of 15—25 mm **51**
51 a Plantule hairy with long, white hairs (Pl. VII, Fig. 46 and 46 a)

46. **Agrostemma githago** L.

51 b Plantule glabrous (Pl. VII, Fig. 47)

47. **Vaccaria pyramidata** Medik.

52 a Petiole of the opposite leaves with base extended ± vaginate ... **53**
52 b Petiole of the opposite leaves with unvaginate base **54**
53 a On the first internodes short hairs all around; leaves with minute, rigid, remote hairs (Pl. VII, Fig. 48 and 48 a)

48. **Arenaria serpyllifolia** L.

53 b First internodes glabrous, or from the internodes 2—3 each with a longitudinal line of hairs; leaves with longer, less rigid hairs (Pl. VII, Fig. 49 and 49 a)

49. **Stellaria media** (L.) Vill.

54 a Leaves with blade nearly round, widely ovate, inversely heart-shaped or obovate, usually shorter than 1 cm **55**
54 b Leaves with lengthened blade, beginning at least with the leaves 3—4 usually longer than 1 cm; if it is shorter, it is markedly narrow and tapered into short petiole **58**
55 a All the nodes with opposite leaves, very shortly petiolate, with blade widely elliptic or obovate, with translucent (!) points (Pl. VIII, Fig. 50 and 50 a)

50. **Hypericum perforatum** L.

55 b Only the first node with opposite leaves, the other ones with alternate leaves, blade without translucent points; plantules with latex turning white **56**

56 a Blade of leaves 4—6 with apex markedly finely toothed (!) (Pl. VIII, Fig. 51 and 51 a)

51. **Euphorbia platyphyllos** L.

56 b Blade of the leaves 4—6 with untoothed apex **57**

57 a Blade wide of 4—6 (—7) mm, nearly round-ovate (Pl. VIII, Fig. 52 and 52 a)

52. **Euphorbia peplus** L.

57 b Blade wide only of 3 mm, ± inversely heart-shaped or obovate (Pl. VIII, Fig. 53)

53. **Euphorbia falcata** L.

58 a Petiole of the leaves 1—6 very short, long at most of 1—2 mm .. **59**

58 b Petiole of the leaves 1—6 longer than 3 mm **61**

59 a Leaves ± linear, wide only of 2 mm (Pl. VIII, Fig. 54)

54. **Euphorbia exigua** L.

59 b Leaves narrowly lanceolate or obovate-lengthened cuneate, wider than 2 mm **60**

60 a Leaves narrowly lanceolate even narrowly elliptic, about the middle or at base wider, thin (Pl. VIII, Fig. 55)

55. **Linaria vulgaris** Mill.

60 b Leaves obovate-lengthened cuneate with rounded or ± truncate apex, wider at the superior third part, ± fleshy (Pl. VIII, Fig. 56)

56. **Portulaca oleracea** L.

61 a Leaves of the first 1—3 nodes with blade narrowly elliptic or linear lanceolate, usually at least three times longer than wide (Pl. VIII, Fig. 57)

57. **Atriplex patula** L.

61 b Leaves of the first 1—3 nodes with blade ovate, widely elliptic or inversely lanceolate; leaves 3—4 sometimes with blade mildly sinuous or toothed **62**

62 a Leaves all glabrous or each of them with some remote hair, first leaves and internodes sometimes glaucous, ± densely mealy because of the tiny shining white granulations (!) **63**
62 b At least beginning with the leaves 3–4 the hairiness marked; hairs long, white (Pl. IX, Fig. 58 and 58 a)

58. **Ajuga chamaepitys** (L.) Schreb.

63 a Leaves with blade ovate, from the round base abruptly tapered into petiole; plantule glaucous, often mealy **64**
63 b Leaves with blade elliptic or obovate-lanceolate, from the narrow base mildly tapered into petiole, plantule glabrescent, unmealy (Pl. IX, Fig. 59)

59. **Valerianella dentata** (L.) Poll.

64 a Leaves with lengthened ovate blade, the superior ones often ± roughly distantly toothed; back of the blade as mealy as the stem; seed lobes narrowly linear (Pl. IX, Fig. 60 and 60 a)

60. **Chenopodium album** L.

64 b Leaves with shortly and broadly ovate blade, superior ones usually untoothed; back of the blade green, unmealy; seed lobes ± ovate (Pl. IX, Fig. 61)

61. **Chenopodium polyspermum** L.

65 a (from 47 b) First 1–6 nodes with alternate leaves; internodes ± marked **66**
65 b First leaves disposed into rosette, internodes unmarked **68**
66 a Apex of the blade acute or obtuse, not emarginate; blade elliptic or elliptic ovate, on the margin glabrous; seed lobes ± elliptic, broad at most of 2–3 mm and long at least of 15 mm (Pl. IX, Fig. 62)

62. **Bupleurum rotundifolium** L.

66 b Apex of the blade blunt or ± truncate, at least beginning with the leaves 3–4 minutely emarginate, with characteristic short bristle (!) **67**
67 a Blade of the seed lobes on the plantules with 3–6 leaves long of 5 mm; foliar blade wide at least of 6–7 mm, usually elliptic, at base ± cuneate tapered into petiole (Pl. IX, Fig. 63)

63. **Amaranthus albus** L.

67 b Blade of the seed lobes on plantules with 3—6 leaves long of 8—10 mm; blade foliar broad at least of 10 mm, broadly ovate or broadly, usually from rounded base, abruptly tapered into petiole (Pl. IX, Fig. 64 and 64 a)

64. **Amaranthus retroflexus** L.

68 a Seed lobes linear filiform, long at least of 2 cm and wide up to 2 mm **69**

68 b Seed lobes of different shape, wider, if they are narrow, blade long at most of 1 cm **70**

69 a Seed lobes and leaves with the same size, linear filiform, uninerved, glabrous (Pl. IV, Fig. 21; Pl. X, Fig. 21 a)

(21) **Spergula arvensis** L.

69 b Seed lobes much narrower and shorter than leaves 2—6; blade 1—3 veined, lanceolate or widely linear, distantly longly pilose (Pl. X, Fig. 65 and 65 a)

65. **Plantago lanceolata** L.

70 a First leaves with simple and branching hairs **71**

70 b First leaves glabrous or only with unbranching hairs **73**

71 a Hairs with 4—5 (6) branches, without pedicel ± appressed, disposed especially on the front side of the foliar blade; simple hairs, disposed usually on the margin of the blade and on the petiole (Pl. X, Fig. 66 and 66 a)

66. **Capsella bursa-pastoris** (L.) Medik.

71 b Hairs with 2—3 (4) branches, with short pedicels, disposed particularly on the margin of the blade; simple hairs more frequent on the front side of the blade and on the petiole **72**

72 a Seed lobes long at most of 4 mm (Pl. VI, Fig. 41 and 41 a; Pl. X, Fig. 41)

(41) **Camelina microcarpa** Andrz.

72 b Seed lobes usually long of about 7 mm (Pl. X, Fig. 67 and 67 a)

67. **Neslia paniculata** (L.) Desv.

73 a Leaves hairy; hairs dense or distant, sometimes very minute (!), at least on the youngest leaves always marked **74**

73 b Leaves completely glabrous, here and there with a hair **79**

74 a Seed lobes with large blade, longer than 1 cm and wider than 5 mm, mildly and longly tapered into petiole (Pl. X, Fig. 68 and 68 a)

68. **Centaurea spinulosa** Roch.

74 b Seed lobes with blade smaller, linear and narrower than 2 mm or nearly-roundly elliptic and wide at most of 4 (5) mm **75**

75 a Leaves distantly hairy or only the margin of the blade minutely ciliate (!) **76**

75 b Leaves densely and markedly hairy **77**

76 a Leaves linear or linear lanceolate, wide at most of 2 mm and long of 10—20 mm, narrowed into petiole ± winged; margin of the blade very minutely ciliate (Pl. X, Fig. 69 and 69 a)

69. **Gypsophila muralis** L.

76 b Leaves ovate elliptic, wider than 2 mm and shorter than 15 mm, abruptly tapered into petiole, with remote hairs (Pl. X, Fig. 70 and 70 a)

70. **Papaver rhoeas** L.

77 a Leaves arachnoid pilose, blade mildly tapered into petiole (as far as next to the base of the leaf), which appears narrowly winged (Pl. X, Fig. 71 and 71 a)

71. **Filago arvensis** L.

77 b Leaves not arachnoid pilose **78**

78 a Blade of the leaves 4—6 slightly toothed (Pl. XI, Fig. 72 and 72 a) (syn. *Conyza canadensis* (L.) Cronq.)

72. **Erigeron canadensis** L.

78 b Blade of the first 6 leaves integer on the margins (Pl. XI, Fig. 73 and 73 a)

73. **Erigeron acer** L.

79 a Seed lobes subsessile, round or widely elliptic, wide of 5—8 mm; leaves ± fleshy, nearly round widely obovate, tapered into very short petiole (Pl. XI, Fig. 74)

74. **Conringia orientalis** (L.) Dum.

79 b Seed lobes markedly petiolate, lengthened or nearly round, wide at most of 5 mm; leaves with thin blade **80**

80 a Leaves with blade mildly and longly tapered into petiole ± winged **81**

80 b At least the first leaves with blade abruptly and shortly tapered into unwinged petioles **82**

81 a Seed lobes with blade acute, narrowly elliptic, wide at most of 2 mm, base of foliar blade unmarkedly asymmetrical; petiole winged to the base (Pl. XI, Fig. 75)

75. **Holosteum umbellatum** L.

81 b Seed lobes with blade rounded or blunt, elliptic or elliptic-ovate, wide of 3—5 mm; foliar blade mostly towards the base markedly asymmetrical ± longly tapered into petiole ± winged (Pl. XI, Fig. 76)

76. **Reseda lutea** L.

82 a Blade of seed lobes ± mildly tapered into petiole, lengthened ovate or lengthened elliptic; beginning with the fifth leaf the blade ± toothed (Pl. XI, Fig. 77) (syn. *Cardaria draba* (L.) Desv.)

77. **Lepidium draba** L.

82 b Blade of seed lobes abruptly narrowed into petiole, roundly elliptic or widely ovate; beginning with the leaf (3) 4 the blade with 1—3 teeth sometimes **83**

83 a Seed lobes with blade markedly longer than wide, roundly elliptic, rounded at the apex (Pl. XI, Fig. 78)

78. **Thlaspi arvense** L.

83 b Seed lobes with blade wider than long, nearly round, widely ovate, blunt or truncate at the apex (Pl. XI, Fig. 79)

79. **Thlaspi perfoliatum** L.

84 a (from 23 b) Leaves trifoliate or with more leaflets, pinnately compound; leaflets ± round or elliptic; entire or toothed; except the first leaf with a single leaflet **85**

84 b Leaves simple with blade toothed or beginning with the second leaf digitate or pinnately divided; if the leaf apparently compound, leaflets are lengthened and 1—3 times divided, ± narrow laciniated **91**

85 a Leaves pinnately compound with 8—12 leaflets small, elliptic, hairy, entire; seed lobes petiolate with blade elliptic, entire (Pl. XII, Fig. 80)

80. **Tribulus terrestris** L.

85 b Leaves trifoliolate; rarely leaves 3—6 with more than 3 leaflets; leaflets roughly toothed; sometimes the first leaf with a single leaflet **86**

86 a First leaf with a single leaflet **87**

86 b First leaf with 3 leaflets **89**

87 a Seed lobes wide of about 2 mm, petiole as long as the half of the blade; first leaf with a single leaflet truncate or slightly emarginate, very finely toothed or untoothed **88**

87 b Seed lobes wide of about 4 mm, with shorter petiole than the half of the blade; first leaf unifoliolate with rounded apex, markedly toothed, tooth in the middle bigger (Pl. XII, Fig. 81)

81. **Medicago lupulina** L.

88 a First leaves with inversely heart-shaped leaflets, with short and equal small petioles; leaflets and petiole hairy (Pl. XII, Fig. 82, 82 a and 82 b)

82. **Trifolium arvense** L.

88 b First leaves with leaflets ovate or obovate, blunt or rounded, only exceptional ± inversely heart-shaped; beginning with the leaves (3) 4—5 the leaflets in the middle with longer small petiole than the lateral ones; leaflets and petiole glabrous (Pl. XII, Fig. 83)

83. **Trifolium campestre** Schreb.

89 a Leaflets ± obovate, roughly toothed, that in the middle markedly, with a longer small petiole; the fourth leaf and the next ones with more leaflets; seed lobes petiolate with hastate or arrow-shaped blade at base (Pl. XII, Fig. 84) (syn. *Poterium sanguisorba* L.)

84. **Sanguisorba minor** Scop.

89 b Leaflets inversely heart-shaped, untoothed; leaves trifoliolate with sessile leaflets; seed lobes petiolate with blade elliptic ovate ± cuneate at base **90**

90 a Hypocotyl, the petiole of seed lobes and at least that of the first 2 leaves glabrous (Pl. XII, Fig. 85)

85. **Oxalis stricta** L.

90 b Hypocotyl, the petiole of seed lobes and that of first leaves hairy (Pl. XII, Fig. 86 and 86 a)

86. **Oxalis corniculata** L.

91 a (from 84 b) Blade of seed lobes cordate, subcordate or arrow-shaped at base; basic seed lobes rounded or acute, divergent, touching or ± sheathing each other **92**

91 b Blade of seed lobes at base usually cuneate, truncate or ± longly tapered into petiole, never heart-shaped or arrow-shaped **101**

92 a Blade of seed lobes with rounded basic lobes, entire or divided; leaves disposed into rosette **93**

92 b Blade of seed lobes subcordate or arrow-shaped, undivided, with acute, minute basic lobes; opposite leaves, internodes usually marked **97**

93 a Blade of seed lobes undivided, heart-shaped or oblique reniform **95**

93 b Blade of seed lobes ± deeply divided, of different shape **94**

94 a Foliar blade pinnately divided, with lobes or segments ± serrate; blade of seed lobes asymmetrical at base, terminal lobe ± larger than the lateral ones (Pl. XIII, Fig. 87)

87. **Erodium cicutarium** (L.) L'Hérit.

94 b Foliar blade palmate (digitate) divided; segment in the middle broad with parallel margins and with 2—3 teeth or lobes at apex; blade of seed lobes symmetric at base, terminal lobe ± oblique emarginate (Pl. XIII, Fig. 88)

88. **Geranium divaricatum** Ehrh.

95 a Blade of seed lobes heart-shaped, narrow towards the blunt apex; blade of leaves unequal ± roughly crenate or crenate-palmate lobed (Pl. XIII, Fig. 89)

89. **Malva pusilla** Sm.

95 b Blade of seed lobes oblique reniform; leaves with blade markedly digitate 7-lobed, lobes blunt, entire or ± crenate **96**

96 a Margin of foliar blade and petiole with long hairs and with shorter glandular (!) hairs (Pl. XIII, Fig. 90 and 90 a)

90. **Geranium pusillum** Burm. f.

96 b Margin of foliar blade and petiole with hairs ± equally long (Pl. XIII, Fig. 91 and 91 a)

91. **Geranium dissectum** Jusl.

97 a At least the opposite leaves of the first node with blade broadly ovate heart-shaped at base **98**

97 b At least the opposite leaves of the first node with blade narrowly lanceolate, elliptic or ovate, cuneate at base **99**

98 a Blade of leaves of the nodes 2—3 shorter than 15 mm, with 7—9 (11) teeth (Pl. XIII, Fig. 92)

92. **Lamium amplexicaule** L.

98 b Blade of leaves of the nodes 2—3 longer than 15 mm, with 11—15 or more teeth (Pl. XIII, Fig. 93 and 93 a)

93. **Lamium purpureum** L.

99 a Leaves of the nodes 2—3 with blade linear elliptic or narrowly lanceolate, wide at most of 5—7 mm (Pl. XIII, Fig. 94 and 94 a)

94. **Galeopsis angustifolia** Hoffm.

99 b Leaves of the nodes 2—3 with blade ovate or lengthened elliptic, wide of about 1 cm or even wider **100**

100 a Leaves of the nodes 2—3 with blade ovate, acute, wide of about 2 cm or even wider (Pl. XIV, Fig. 95)

95. **Galeopsis pubescens** Bess.

100 b Leaves of the nodes 2—3 with blade lengthened ovate or lengthened elliptic, blunt narrower or only a bit wider of 1 cm (Pl. XIV, Fig. 96)

96. **Galeopsis ladanum** L.

101 a (from 91 b) Blade of seed lobes with apex curved deeply, widely emarginate, usually rounded bilobed (Pl. XIV, Fig. 97 a and 103) ... **102**

101 b Blade of seed lobes with apex rounded, acute, blunt, truncate or slightly submarginate **109**

102 a Hypocotyl spreading densely white pilose; first leaves ± lyrate, with the terminal segment deeply sinuous split, to pinnately sectate (Pl. XIV, Fig. 97, 97 a and 97 b)

97. **Sinapis alba** L.

102 b Hypocotyl glabrous or only with 1—2 distant hairs **103**

103 a Margin of foliar blade of first leaves with hairs appressed, characteristically arch-like curved at the base (Pl. XIV, Fig. 98 and 98 a)

98. **Brassica elongata** Ehrh.

103 b Margin of foliar blade of the first leaves glabrous or only with straight, uncurved hairs **104**

104 a Blade of first 1—3 leaves ± entire, slightly sinuous or slightly distant toothed, lengthened obovate or elliptic, undivided (Pl. XIV, Fig. 99)

99. **Eruca sativa** Mill.

104 b Blade of first 1—3 leaves usually finely or roughly toothed, sometimes towards the base of the blade with marked lobes or with some small segments ± separated **105**

105 a Middle vein on the back of the first leaves with hairs markedly inclined towards the apex of the blade; leaves 3—4 with blade ovate or elliptic, minutely unequally toothed; usually no separated segments (Pl. XIV, Fig. 100 and 100 a)

100. **Sinapis arvensis** L.

105 b Middle vein on the back of blade of the first leaves glabrescent or with hairs spreading, markedly uncurved towards the apex of blade .. **106**

106 a At least the leaves 2—3 with blade ± longly narrowed at base and with 1—2 small, separated segments; leaf sublyrate or ± lyrate **107**

106 b At least the leaves 2—3 with blade without separated segments; foliar blade under-round, elliptic-ovate or obovate, undivided, minutely or ± roughly toothed **108**

107 a Segments separated from the base of blade markedly appear, even by the first 1—2 leaves; the (third) fourth leaf markedly lyrate, with the terminal segment more deeply divided (Pl. XIV, Fig. 101)

101. **Raphanus raphanistrum** L.

107 b Segments separated from the base of blade markedly appear usually only by the third leaf; the (third) fourth leaf sublyrate or not lyrate, slightly divided (Pl. XIV, Fig. 102)

102. **Brassica nigra** (L.) Koch

108 a First leaves with blade round or nearly round, markedly roughly toothed (Pl. XIV, Fig. 103)

103. **Brassica napus** L. var. **arvensis** (Lam.) Thell.

108 b First leaves with blade elliptic, ovate or obovate, minutely toothed, with base narrowed into petiole or ± asymmetrical (Pl. XIV, Fig. 104)

104. **Brassica rapa** L. f. **campestris** (L.) Bogenh.

109 a Nodes all or at least the first ones with opposite leaves, usually with marked internodes **110**

109 b Nodes all with alternate leaves, with marked internodes or first leaves disposed into rosette, without marked internodes **119**

110 a Seed lobes with blade linear or linear lanceolate mildly tapered into petiole, together with the petiole long of about 20 mm and wide to 3 mm; foliar blade ± triangular, towards the base with 1—2 (3) marked teeth (Pl. XV, Fig. 105)

105. **Chenopodium hybridum** L.

110 b Seed lobes with blade ± round, only a bit longer than wide, with well distinct petiole **111**

111 a First and next leaves pinnately parted or sectate, with entire or divided segments; hypocotyl and epicotyl usually reddish (Pl. XV, Fig. 106) (syn. *Ambrosia elatior* L.)

106. **Ambrosia artemisiifolia** Torr. et Gray

111 b Leaves with undivided blade, sometimes ± toothed to sublobate **112**

112 a Only the first and sometimes the second node with opposite leaves, blade of leaves mildly tapered into petiole, minutely toothed towards the apex. Plant with latex (Pl. XV, Fig. 107)

107. **Euphorbia helioscopia** L.

112 b Nodes all with opposite leaves, blade of leaves abruptly tapered into petiole, frequently with truncate base, with toothed margins, plant without latex **113**

113 a Apex of foliar blade acute **114**

113 b Apex of foliar blade rounded or blunt **115**

114 a Epicotyl marked ± densely hairy; blade of upper leaves rough and distantly toothed; blade of seed lobes unhairy on margin or only with one short glandular (!) hair (Pl. XV, Fig. 108 and 108 a) (syn. *Galinsoga quadriradiata* auct. non Ruiz et Pav.)

108. **Galinsoga ciliata** (Raf.) Blake

114 b Epicotyl glabrous or glabrescent, blade of upper leaves finely and distantly toothed, blade of seed lobes with glandular, distant hairs on margin (!) (Pl. XV, Fig. 109 and 109 a)

109. **Galinsoga parviflora** Cav.

115 a Blade of leaves roughly toothed, teeth relatively narrow, long of 2—4 mm; plant with ± marked urticant hairs (Pl. XV, Fig. 110)

110. **Urtica urens** L.

115 b Blade of leaves with smaller teeth, long at most of 2 mm, plant without urticant hairs **116**

116 a Blade of seed lobes and of first leaves with minute and glandular hairs on the margins (Pl. XV, Fig. 111)

111. **Scrophularia scopolii** Hoppe

116 b Blade of seed lobes glabrous; blade of first leaves ciliate, unglandular (!) **117**

117 a Foliar blade markedly netted, veined; veins of the order 2—3 marked, anastomosate; base of blade ± tapered into petiole (Pl. XV, Fig. 112 and 112 a)

112. **Stachys annua** L.

117 b Foliar blade unmarkedly netted; base of blade truncate or ± heart-shaped **118**

118 a Foliar blade usually with 3—5 (7) teeth, terminal tooth markedly broader than the lateral ones; blade usually broader than long (Pl. XV, Fig. 113)

113. **Veronica hederifolia** L

118 b Foliar blade usually with 9—13 teeth; terminal tooth is not markedly broader than long; blade usually longer than broad (Pl. XV, Fig. 114) (syn. *Veronica tournefortii* C. C. Gmel. non F. W. Schmidt)

114. **Veronica persica** Poir.

119 a (from 109 b) Seed lobes narrow. At least the second leaf as well as the next ones pinnate or palmate ± deeply divided, sometimes compound, narrow, laciniated **120**

119 b Seed lobes broad, frequently nearly rounded; blade of first leaves toothed or sometimes deeply divided; if the blade of seed lobes is narrow, the blade of first leaves only toothed **128**

120 a Plantule 4—6 foliated with simple, pinnately divided leaves **121**

120 b Plantule 4—6 foliated with compounded or simple palmate, divided leaves; if leaves are simple and pinnately divided or compound, segments, respectively, leaflets are pinnately divided again; rarely first leaf ± entire **122**

121 a Blade of leaves pinnately sectate; segments narrow, linear, distant, undivided or 1—2 (3) linear laciniated (Pl. XVI, Fig. 115)

115. **Lepidium perfoliatum** L.

121 b Blade of leaves pinnately lobed or splitted, with lobes broad, approached, entire ± toothed (Pl. X, Fig. 70, 70 a and Pl. XVI, Fig. 70 b)

(70) **Papaver rhoeas** L·

122 a Seed lobes long to 3 cm **123**

122 b Seed lobes usually longer than 3 cm **126**

123 a Blade of leaves 1—2 digitate, trilobate or tridentate; leaves 3—4 and next ones with blade digitate-parted or sectate, frequently with middle segment again deeply divided; first leaf sometimes with entire blade (Pl. XVI, Fig. 116)

116. **Nigella arvensis** L.

123 b Blade of leaves 1—2 and of next ones usually sectate, with segments frequently again sectate or leaves compound **124**

124 a The final parts of leaf segments abruptly narrowed into blunt or rounded apex (Pl. XVI, Fig. 117 and 117 a)

117. **Fumaria schleicheri** Soy.-Will.

124 b The final parts of leaf segments longly narrowed into acute apex **125**

125 a The final parts of leaf segments acute, slightly awned, hairy on the margins; seed lobes linear, wide of 1—2 mm (Pl. XVI, Fig. 118 and 118 a)

118. **Daucus carota** L. ssp. **carota**

125 b The final part of leaf segments acute, without awns, with glabrous margins; seed lobes narrowly lanceolate, wide of 3—4 mm (Pl. XVI, Fig. 119, 119 a and 119 b)

119. **Adonis aestivalis** L.

126 a Leaves 1—3 digitate divided, with broad, cuneate, toothed or ± lobed segments. Plantule with characteristic, unpleasant smell (Pl. XVI, Fig. 120)

120. **Bifora radians** M. B.

126 b Leaves 1—3 and the next ones deeply pinnately divided or pinnately compound, with segments, respectively, leaflets again divided ... **127**

127 a Leaves with blade and petiole glabrous or distantly slightly pilose (Pl. XVI, Fig. 121 and 121 a)

121. **Scandix pecten-veneris** L.

127 b Leaves with blade and petiole short, minutely dense and white hairy (Pl. XVII, Fig. 122 and 122 a) (syn. *Caucalis platycarpos* L.)

122. **Caucalis lappula** (Webb.) Grande

128 a Leaves 1—4 with blade mildly or ± abruptly narrowed into petiole, truncate at base or sometimes cuneate **136**

128 b Leaves at least 3—4 and the next ones with blade heart-shaped or slightly heart-shaped at base **129**

129 a Leaf 1—2 (3) with sinuous ± toothed blade **130**

129 b Leaf 1—2 and the next ones with blade deeply digitate divided or at least lobed or splitted at the apex, with toothed lobes sometimes **132**

130 a First 3 (4) leaves with slightly sinuous blade, the next ones at base of blade with small, distant segments (Pl. XVII, Fig. 123)

123. **Barbaraea vulgaris** R. Br.

130 b Leaves all with markedly toothed, serrate or crenate blade .. **131**
131 a Foliar blade widely ovate, crenate; plant hairy (Pl. XVII, Fig. 124 and 124 a)

124. **Campanula rapunculoides** L.

131 b Foliar blade elliptic or rounded elliptic, dense, minute and uniformely crenate-serrate; plant glabrous (Pl. XVII, Fig. 125)

125. **Falcaria vulgaris** Bernh.

132 a Leaves 2—4 and the next ones with blade digitate sectate or digitate parted; segments deeply divided again **133**
132 b Leaves 2—3 and the next ones with lobed or at most splitted blade, lobes entire or ± toothed **134**
133 a Segments ciliate (!); plantule 3—4 foliate with blade or seed lobes ± ovate, abruptly tapered into petiole (Pl. XVII, Fig. 126 and 126 a)

126. **Delphinium consolida** L.

133 b Segments glabrous or very minute ± hairy (!); plantule 3—4 foliated with blade of seed lobes elliptic, mildly tapered into petiole (Pl. XVII, Fig. 127)

127. **Aethusa cynapium** L.

134 a Margin of blade and petiole of the seed lobes with short secretory hairs; foliar blade with serrate, rigid short hairy lobes (Pl. XVII, Fig. 128 and 128 a)

128. **Rubus caesius** L. var. **arvalis** Rchb.

134 b Margin of blade and petiole of the seed lobes glabrous; foliar blade usually with untoothed lobes without rigid hairs **135**
135 a Foliar blade with white, distant hairs on both sides (Pl. XVII, Fig. 129 and 129 a)

129. **Ranunculus repens** L.

135 b Foliar blade glabrous on both sides, margin sometimes with solitary distant hairs (Pl. XVII, Fig. 130)

130. **Ranunculus sardous** Cr.

136 a Foliar blade with hairs stellate, at least beginning with the blad of the third leaf digitate, divided (Pl. XVIII, Fig. 131 and 131 a)

131. **Hibiscus trionum** L.

136 b Foliar blade glabrous or with simple hairs; if it is stellate hairy, then the blade of the leaves 1—6 is pinnately divided or only toothed **137**

137 a First 1—3 leaves with blade cuneate or spatulate, broader towards the apex, toothed only towards the apex **138**

137 b First leaves of different shape, deeply divided, or undivided and toothed to the base **139**

138 a Seed lobes lengthened or narrowly elliptic-ovate, sometimes slightly rounded, wider than 5 mm; first leaves ± spatulate, roughly toothed at the apex (Pl. XVIII, Fig. 132)

132. **Ranunculus arvensis** L.

138 b Seed lobes linear lanceolate, wide at most of 2—3 mm; first leaves cuneate, with 3 (4) minute teeth on the truncate apex (Pl. XVIII, Fig. 133)

133. **Glaucium corniculatum** (L.) Rudolph

139 a Seed lobes sessile or subsessile; leaves 3—4 and the next ones pinnately sectate; segments integral or again deeply divided, ± narrowed towards the base, leaves 1—2 sometimes slightly divided or undivided . . . **140**

139 b Seed lobes markedly petiolate; leaves 3—4 toothed, undivided, sometimes pinnately lobed or splitted, with lobes widened towards the base, the 2 inferior lobes mildly tapered into petiole **142**

140 a Middle vein of the leaf between segments with narrow wings, markedly broader towards the apex of the leaf (Pl. XVIII, Fig. 134)

134. **Achillea millefolium** L.

140 b Middle vein of the leaf between segments with wings over all ± uniformly narrow **141**

141 a First leaves pilose; segments with lobes or short teeth; plantule with characteristic smell (Pl. XVIII, Fig. 135 and 135 a)

135. **Anthemis arvensis** L.

141 b First leaves glabrous or only with some single distant hairs; segments with lobes or teeth narrower and relatively longer, plantule without characteristic smell (Pl. XVIII, Fig. 136) (syn. *Tripleurospermum inodorum* (L.) C. H. Schultz)

136. **Matricaria inodora** L.

142 a Plantule 5—6 foliated minutely hairy at least on the margin of the blade or also on the petiole; sometimes only the hypocotyl, blade or petiole of the seed lobes hairy (!) **143**

142 b Plantule 5—6 foliated glabrous or only with some single distant hair **156**

143 a Plantule with branching or stellate hairs **144**
143 b Plantule with simple hairs **145**
144 a Hairs bifurcate or stellate, usually 2—4 branched; simple hairs are missing; seed lobes hairy (Pl. VI, Fig. 43, 43 a and 43 b; Pl. XVIII, Fig. 43 c)

(43) **Erysimum repandum** Höjer

144 b Hairs stellate, usually 5—6 branched and simple hairs. Seed lobes glabrous (Pl. X, Fig. 66 and 66 a; Pl. XVIII, Fig. 66 b)

(66) **Capsella bursa-pastoris** (L.) Medik.

145 a Blade of seed lobes or at least the petiole of the seed lobes with distant or dense hairs **146**
145 b Blade and petiole of the seed lobes glabrous **148**
146 a Foliar blade mildly narrowed into petiole, minutely and distantly serrate (Pl. XVIII, Fig. 137 and 137 a) (syn. *Lactuca scariola* L.)

137. **Lactuca serriola** Torner

146 b Foliar blade abruptly tapered into marked petiole **147**
147 a Blade of seed lobes ovate, on the margins with minute (!), distant hairs; foliar blade markedly slightly sinuous subdentate (Pl. XVIII, Fig. 138 and 138 a)

138. **Kickxia elatine** (L.) Dum.

147 b Blade of seed lobes widely elliptic, only the petiole with distant hairs; foliar blade markedly crenate-serrate (Pl. XV, Fig. 112 and 112 a; Pl. XVIII, Fig. 112 b and 112 c)

(112) **Stachys annua** L.

148 a At least the third leaf pinnately lobed or pinnately splitted, with lobes serrate, hairy, widened towards the base; seed lobes elliptic, wide of about 2 mm (Pl. XVIII, Fig. 139)

139. **Senecio vulgaris** L.

148 b Leaves undivided, only toothed **149**
149 a Hairs multicellular on the leaf having the shape of a narrowed chain or string of pearls, frequently mixed with simple hairs margin of foliar blade usually ± bristly spiny **150**
149 b Multicellular hairs of different shape or missing; margin of foliar blade usually not bristly or spiny **153**

150 a Leaves shortly petiolate; foliar blade elliptic, not uniformly bristly spiny toothed, tapered into petiole; hairs multicellular having the shape of a narrowed straight chain, mixed with simple hairs (Pl. XIX, Fig. 140 and 140 a)

140. **Cirsium arvense** (L.) Scop.

150 b Leaves, at least 3—4, longer petiolate; foliar blade inversely lanceolate, obovate or widely elliptic, ± toothed; teeth not uniform, slightly orientated downwards, with thorny apex, sometimes at the base of the blade with acute ± distant lobes or segments, only hairs like a string of pearls **151**

151 a Leaves at least 3—4 inversely lanceolate, mildly and broadly tapered into petiole (Pl. XIX, Fig. 141 and 141 a)

141. **Sonchus arvensis** L.

151 b Leaves 1—4 obovate or widely elliptic, abruptly tapered into petiole; base of blade acute, under it on the petiole sometimes 1—2 ± distant lobes or segments **152**

152 a Blade of leaves 1—6 without distant segments at their base (Pl. XIX, Fig. 142)

142. **Sonchus asper** (L.) Hill

152 b At least at 3—6 leaves under the base of blade on the petiole with 1—2 lobes or ± distant segments (Pl. XIX, Fig. 143)

143. **Sonchus oleraceus** L.

153 a Foliar blade nearly rounded or lengthened ovate, uniformly crenate-toothed; petiole with minute downwards orientated hairs (Pl. XIX, Fig. 144 and 144 a)

144. **Viola arvensis** Murr.

153 b Foliar blade elliptic, narrowly obovate or narrowly inversely lanceolate elliptic **154**

154 a Foliar blade narrowly inversely lanceolate elliptic, distant minutely serrate, ± appressed long-haired; seed lobes wide of 5—6 mm (Pl. XIX, Fig. 145 and 145 a)

145. **Centaurea cyanus** L.

154 b Foliar blade broader, often of different shape; seed lobes smaller' narrower **155**

155 a Blade of leaves 4—6 from the base to the apex uniformly toothed; petiole and blade hairy (Pl. XIX, Fig. 146 and 146 a)

146. **Senecio vernalis** W. et K.

155 b Blade of leaves 4—6 subruncinate, distantly toothed especially towards the narrowed base; hairiness dispersed, minute or only with some longer, distant hair; plantule with latex (Pl. XIX, Fig. 147 and 147 a)

147. **Taraxacum officinale** F. Webb.

156 a (from 142 b) Blade of seed lobes mildly and longly tapered into petiole ± winged **157**

156 b Blade of seed lobes abruptly tapered into petiole ± long, unwinged **158**

157 a Blade of leaves 2—6 distant, roughly sinuously toothed, nearly lobed, with 5 (7) teeth (Pl. XIX, Fig. 148)

148. **Myagrum perfoliatum** L.

157 b Blade of leaves 2—6 distant, minutely toothed or subintegral (Pl. XIX, Fig. 149)

149. **Cichorium intybus** L.

158 a Leaves all with blade slightly sinuous or ± toothed, without deeper incisions (Pl. XI, Fig. 78; Pl. XIX, Fig. 78 a)

(78) **Thlaspi arvense** L.

158 b Leaves at least 3—5 with blade pinnately lobed to pinnately sected; first leaves undivided or only sinuous **159**

159 a Foliar blade cuneate at base and ± longly tapered into petiole; blade of seed lobes very slightly emarginate; plantule with characteristic smell (Pl. XIX, Fig. 150)

150. **Diplotaxis muralis** (L.) DC.

159 b Foliar blade cuneate at base, abruptly tapered into petiole; blade of seed lobes with rounded apex; plantule without characteristic smell (Pl. XIX, Fig. 151)

151. **Rorippa silvestris** (L.) Bess.

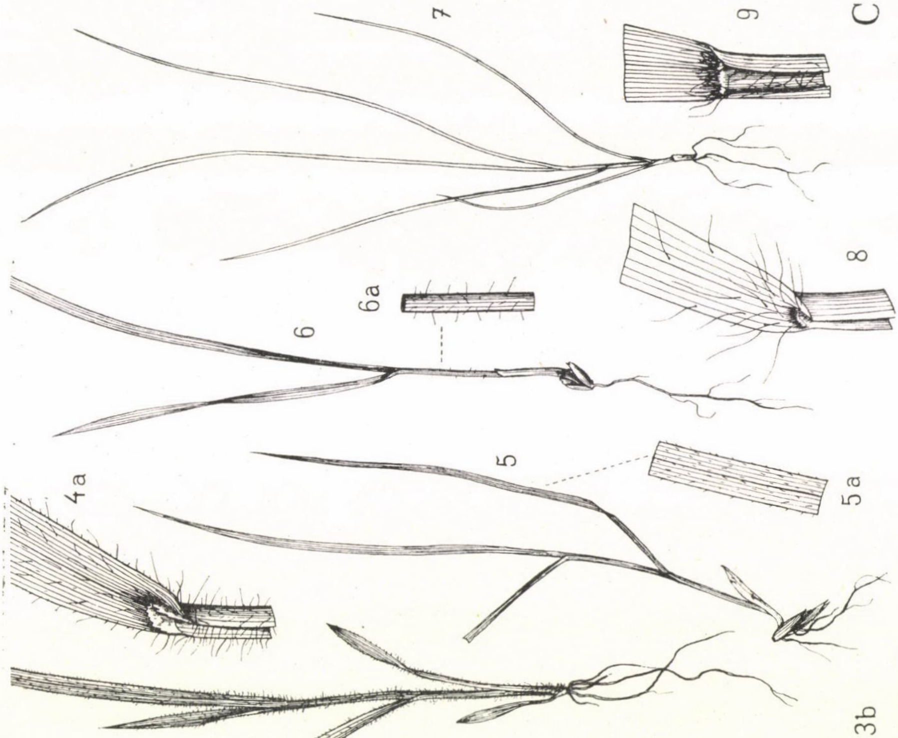

Plate I. 1, 1a — *Avena fatua*; 2, 2a — *Echinochloa crus-galli*; 3, 3a, 3b — *Setaria verticillata*; 4, 4a — *Digitaria sanguinalis*; 5, 5a — *Agropyron repens*; 6, 6a — *Bromus secalinus*; 7 — *Apera spica-venti*; 8 — *Setaria glauca*; 9 — *Setaria viridis*

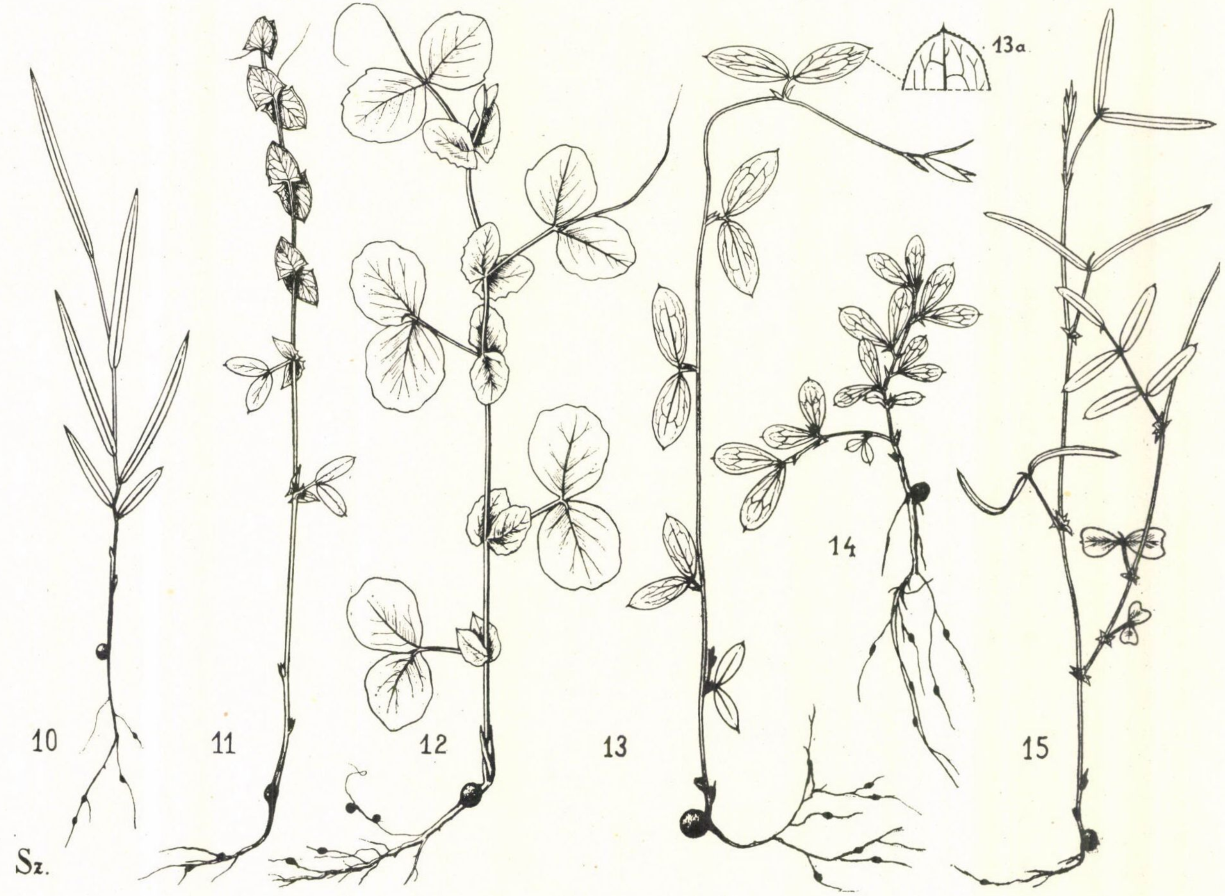

Plate II. 10 — *Lathyrus nissolia;* 11 — *Lathyrus aphaca;* 12 — *Pisum arvense;* 13, 13a — *Lathyrus hirsutus;* 14 — *Lathyrus tuberosus;* 15 — *Vicia sativa*

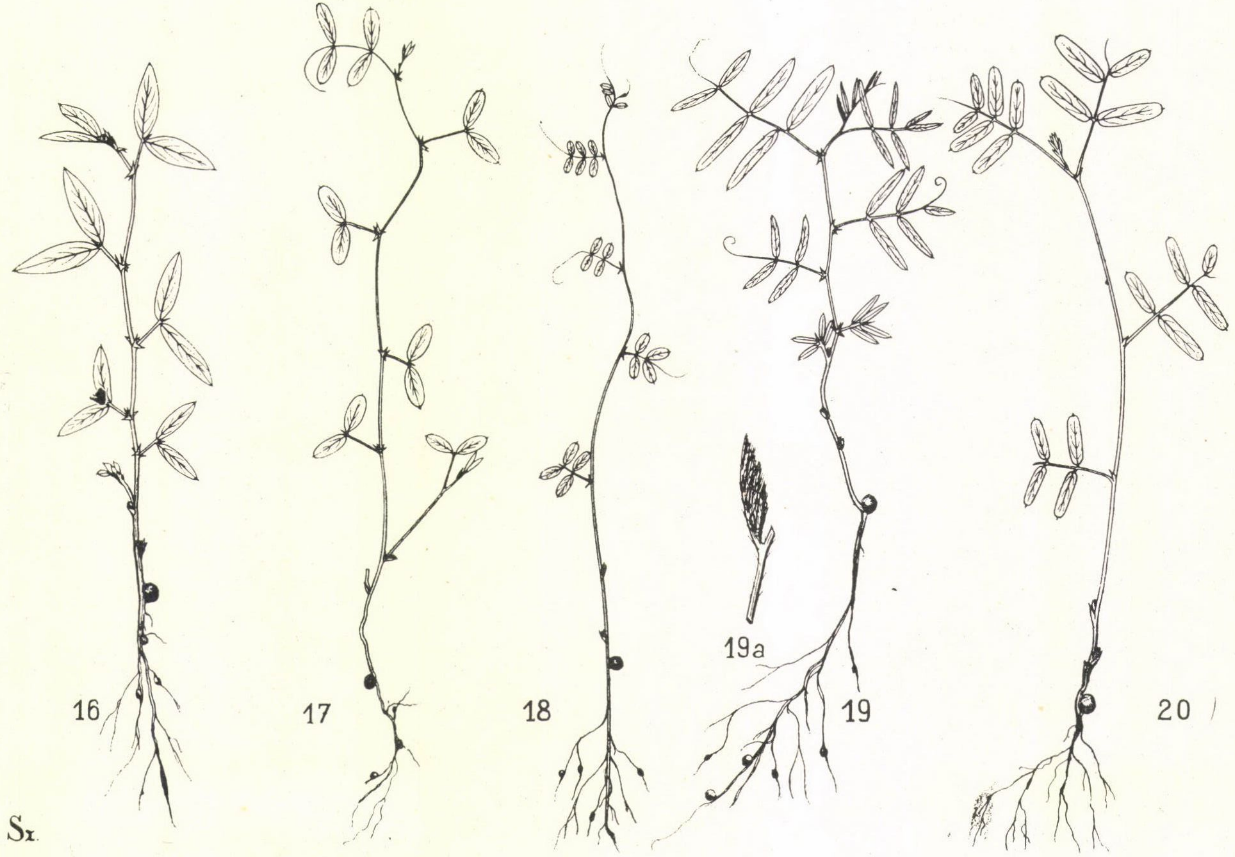

Plate III. 16 — *Vicia angustifolia*; 17 — *Vicia tetrasperma*; 18 — *Vicia hirsuta*; 19, 19a — *Vicia villosa*; 20 — *Vicia pannonica*

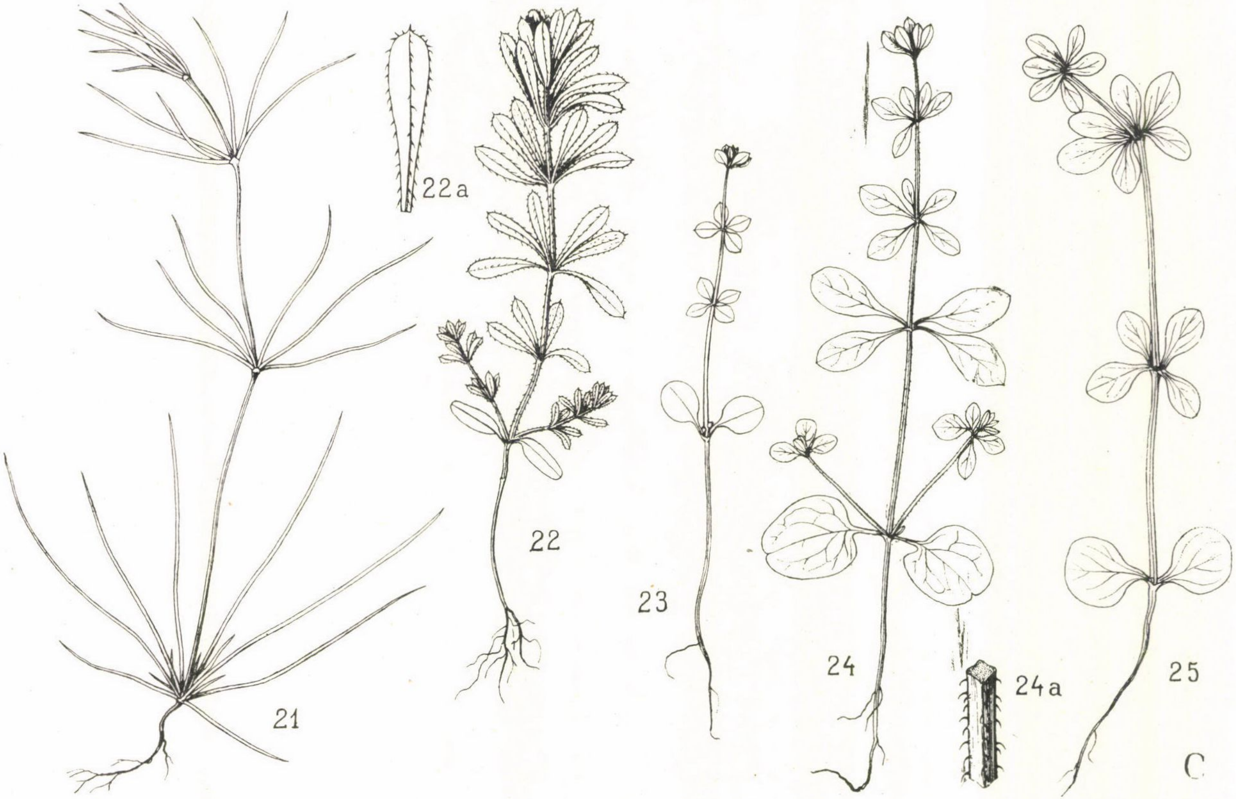

Plate IV. 21 — *Spergula arvensis*; 22, 22a — *Galium tricorne*; 23 — *Sherardia arvensis*; 24, 24a — *Galium aparine*; 25 — *Asperula arvensis*

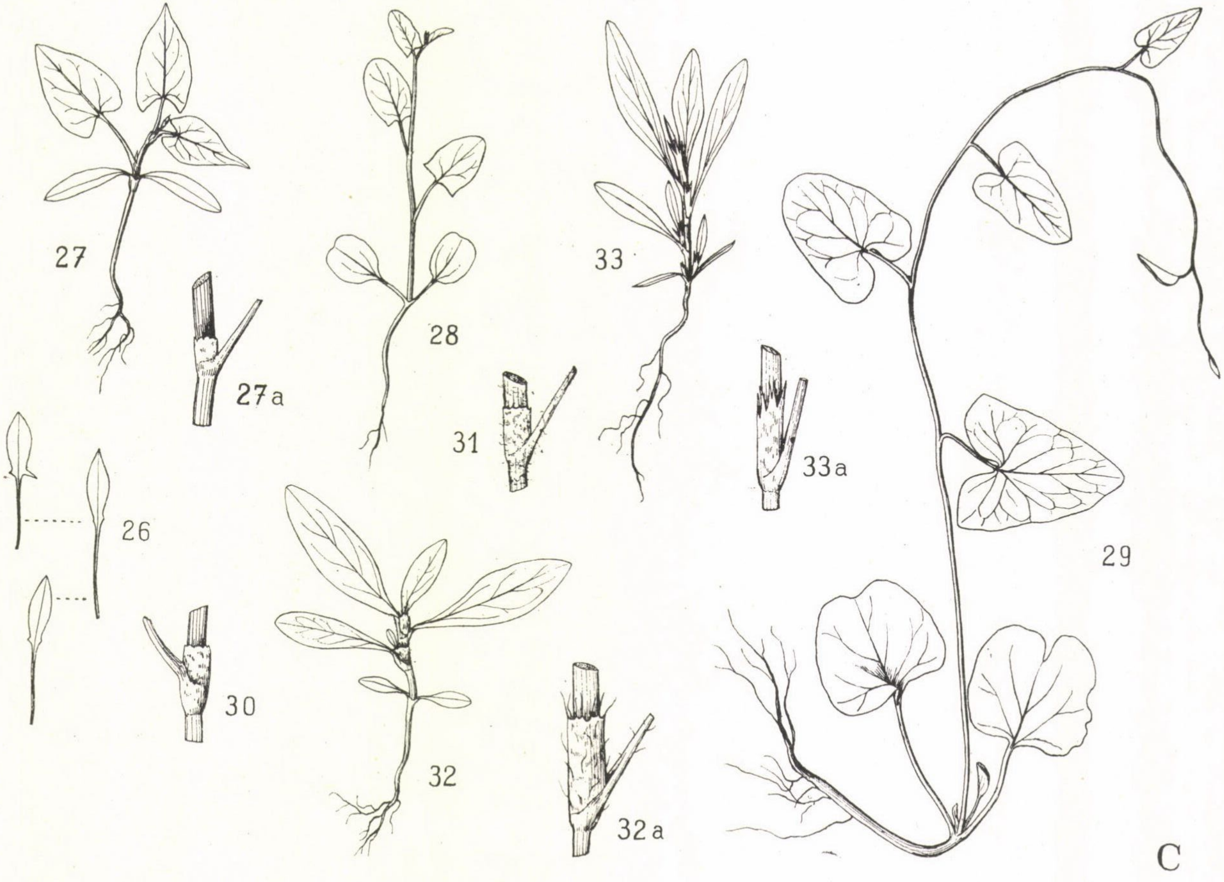

Plate V. 26 — *Rumex acetosella*; 27, 27a — *Fagopyrum convolvulus*; 28 — *Convolvulus arvensis*; 29 — *Calystegia sepium*; 30 — *Polygonum amphibium* var. *terrestre*; 31 — *Polygonum lapathifolium*; 32, 32a — *Polygonum persicaria*; 33, 33a — *Polygonum aviculare*

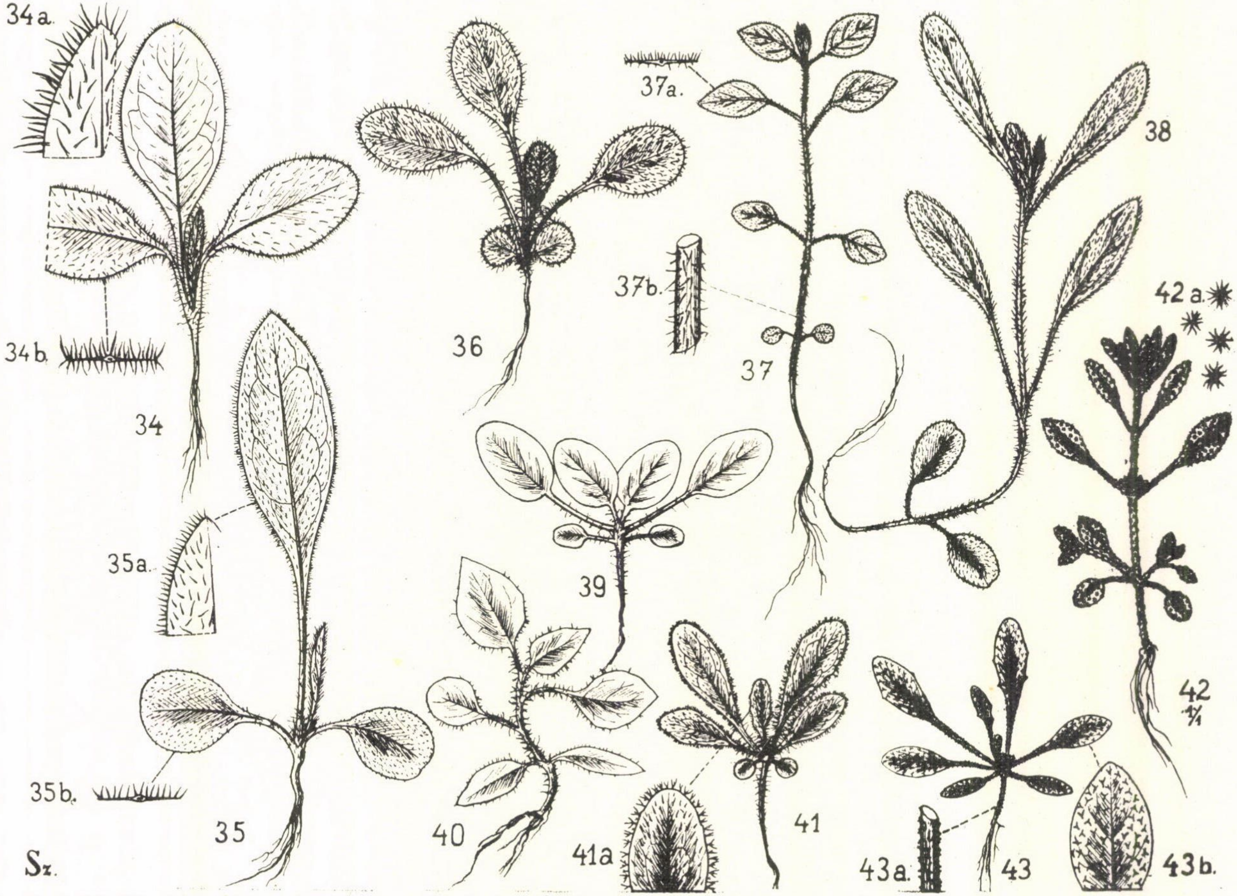

Plate VI. 34, 34a, 34b — *Symphytum officinale;* 35, 35a, 35b — *Cynoglossum officinale;* 36 — *Myosotis arvensis;* 37, 37a, 37b —*Heliotropium europaeum;* 38 — *Lithospermum arvense;* 39 — *Kickxia spuria;* 40 — *Solanum nigrum;* 41, 41a — *Camelina microcarpa;* 42, 42a — *Alyssum alyssoides;* 43, 43a, 43b — *Erysimum repandum*

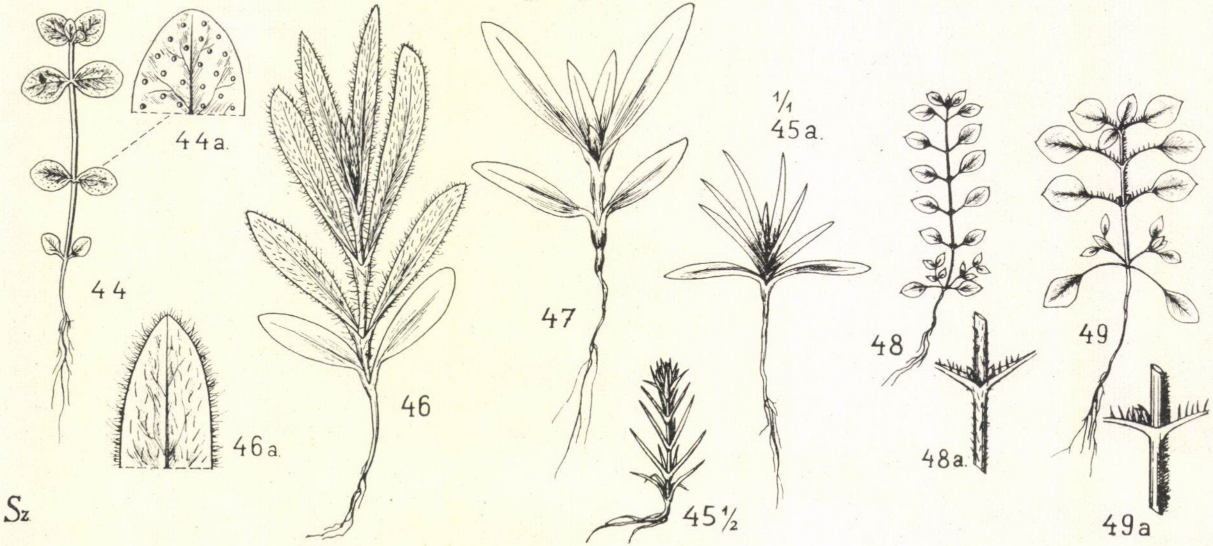

Plate VII. 44, 44a — *Anagallis arvensis;* 45, 45a — *Scleranthus annuus;* 46 — *Agrostemma githago;* 47 — *Vaccaria pyramidata;* 48, 48a — *Arenaria serpyllifolia;* 49, 49a — *Stellaria media*

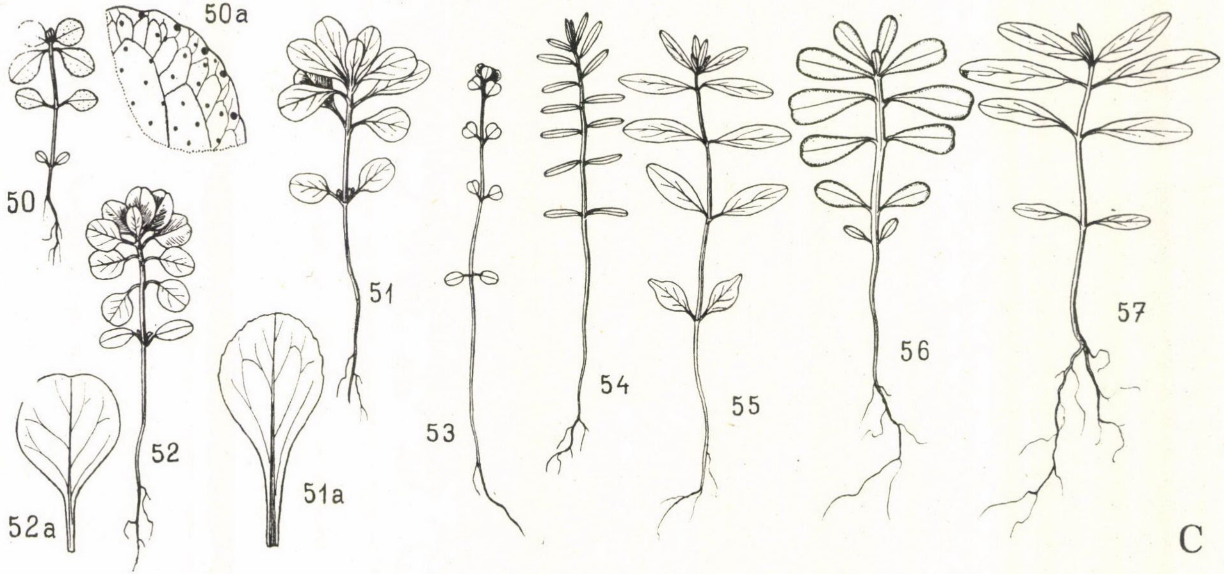

Plate VIII. 50, 50a — *Hypericum perforatum;* 51, 51a — *Euphorbia platyphyllos;* 52, 52a — *Euphorbia peplus;* 53 — *Euphorbia falcata;* 54 — *Euphorbia exigua;* 55 — *Linaria vulgaris;* 56 — *Portulaca oleracea;* 57 — *Atriplex patula*

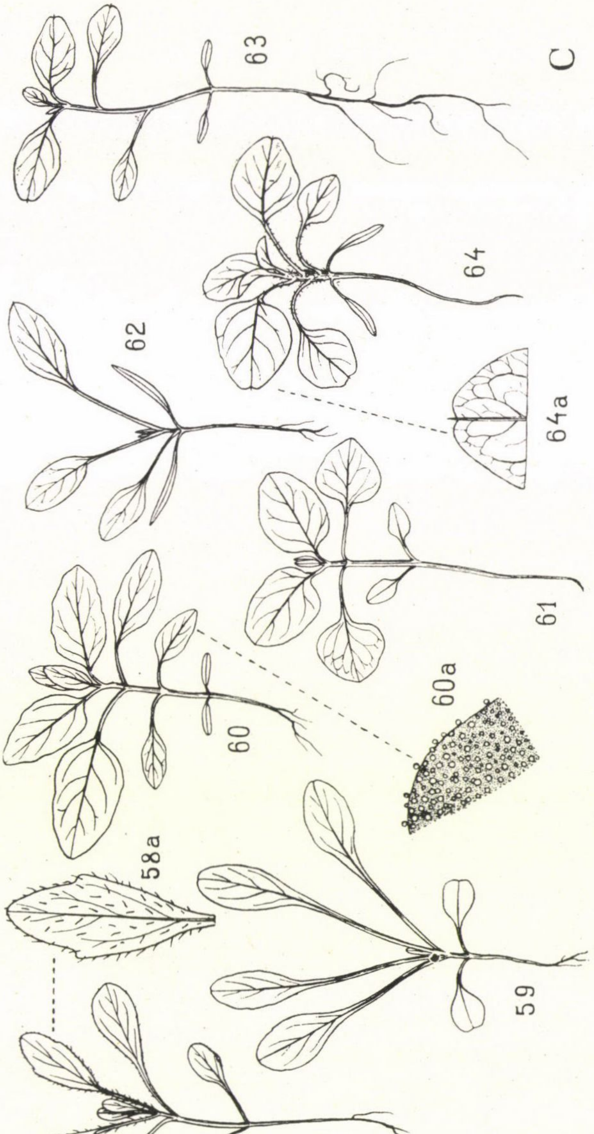

Plate IX. 58, 58a — *Ajuga chamaepitys*; 59 — *Valerianella dentata*; 60, 60a — *Chenopodium album*; 61 — *Chenopodium polyspermum*; 62 — *Bupleurum rotundifolium*; 63 — *Amaranthus albus*; 64, 64a — *Amaranthus retroflexus*

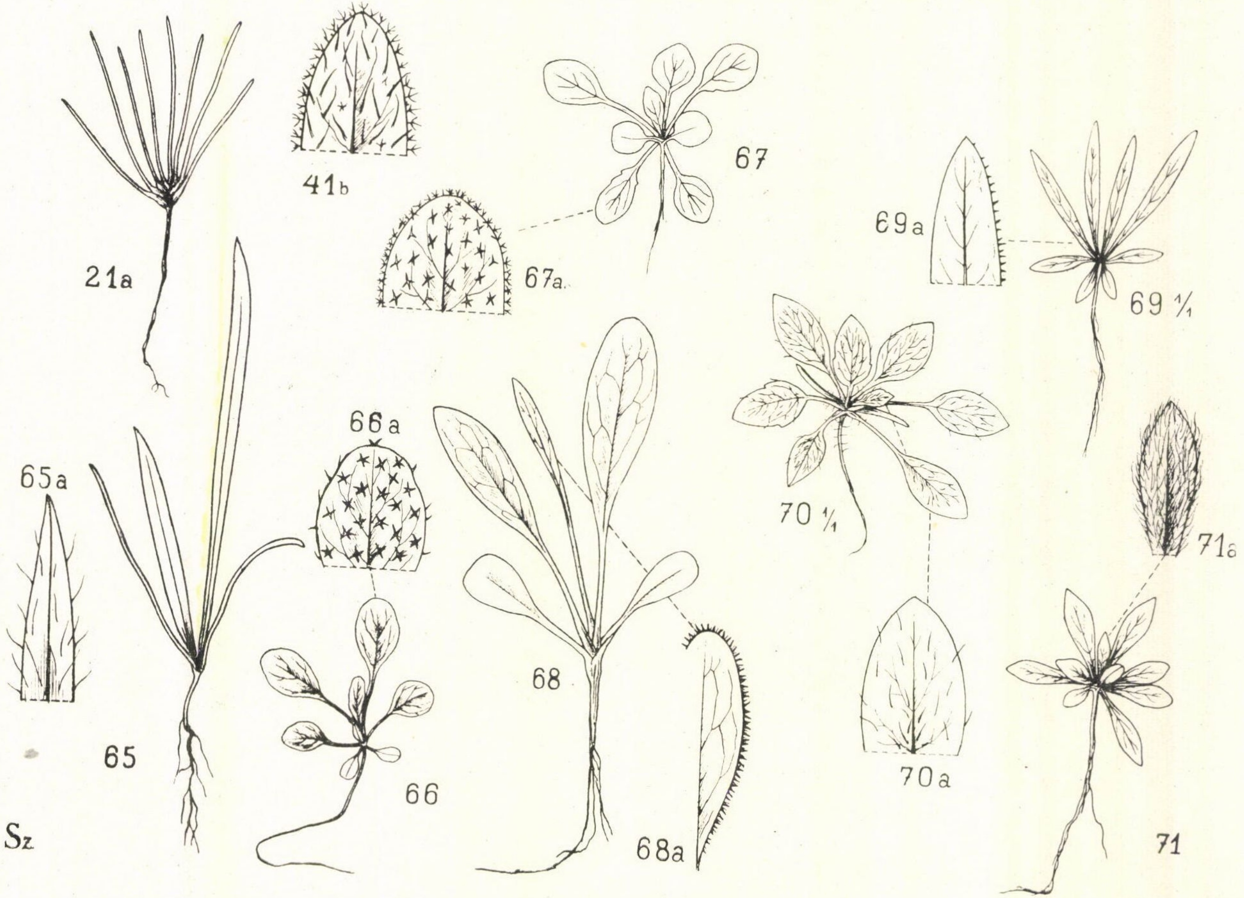

Plate X. 21a — *Spergula arvensis;* 41b — *Camelina microcarpa;* 65, 65a — *Plantago lanceolata;* 66, 66a — *Capsella bursa-pastoris;* 67, 67a — *Neslia paniculata;* 68, 68a — *Centaurea spinulosa;* 69, 69a — *Gypsophila muralis;* 70, 70a — *Papaver rhoeas;* 71, 71a — *Filago arvensis*

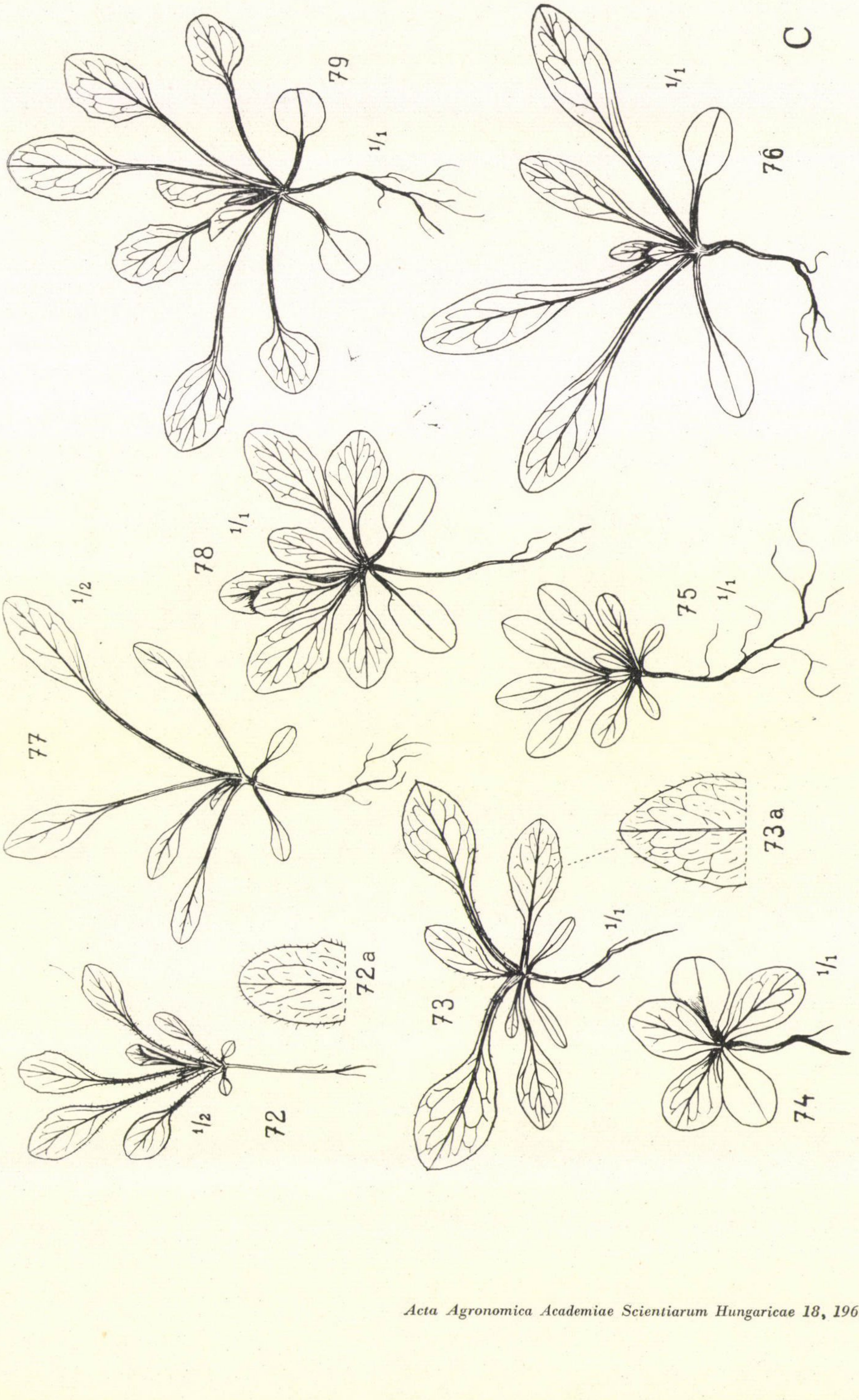

Plate XI. 72, 72a — *Erigeron canadensis*; 73, 73a — *Erigeron acer*; 74 — *Conringia orientalis*; 75 — *Holosteum umbellatum*; 76 — *Reseda lutea*; 77 — *Lepidium draba*; 78 — *Thlaspi arvense*; 79 — *Thlaspi perfoliatum*

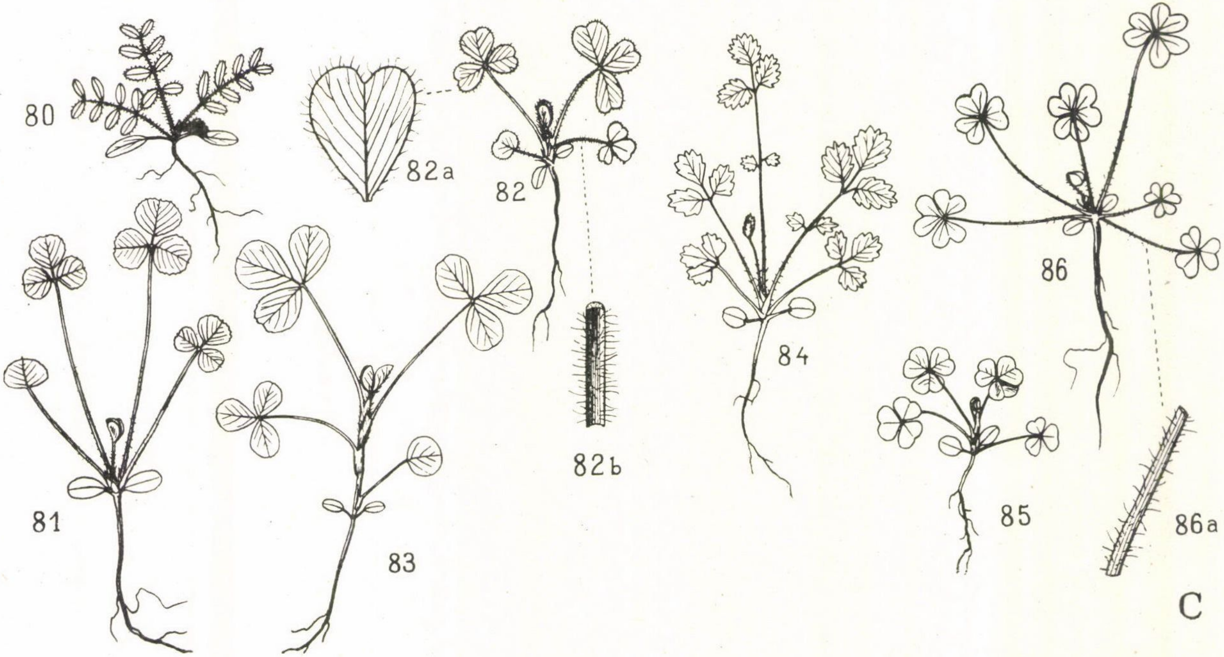

Plate XII. 80 — *Tribulus terrestris;* 81 — *Medicago lupulina;* 82, 82a, 82b — *Trifolium arvense;* 83 — *Trifolium campestre;* 84 — *Sanguisorbam minor;* 85 — *Oxalis stricta;* 86, 86a — *Oxalis corniculata*

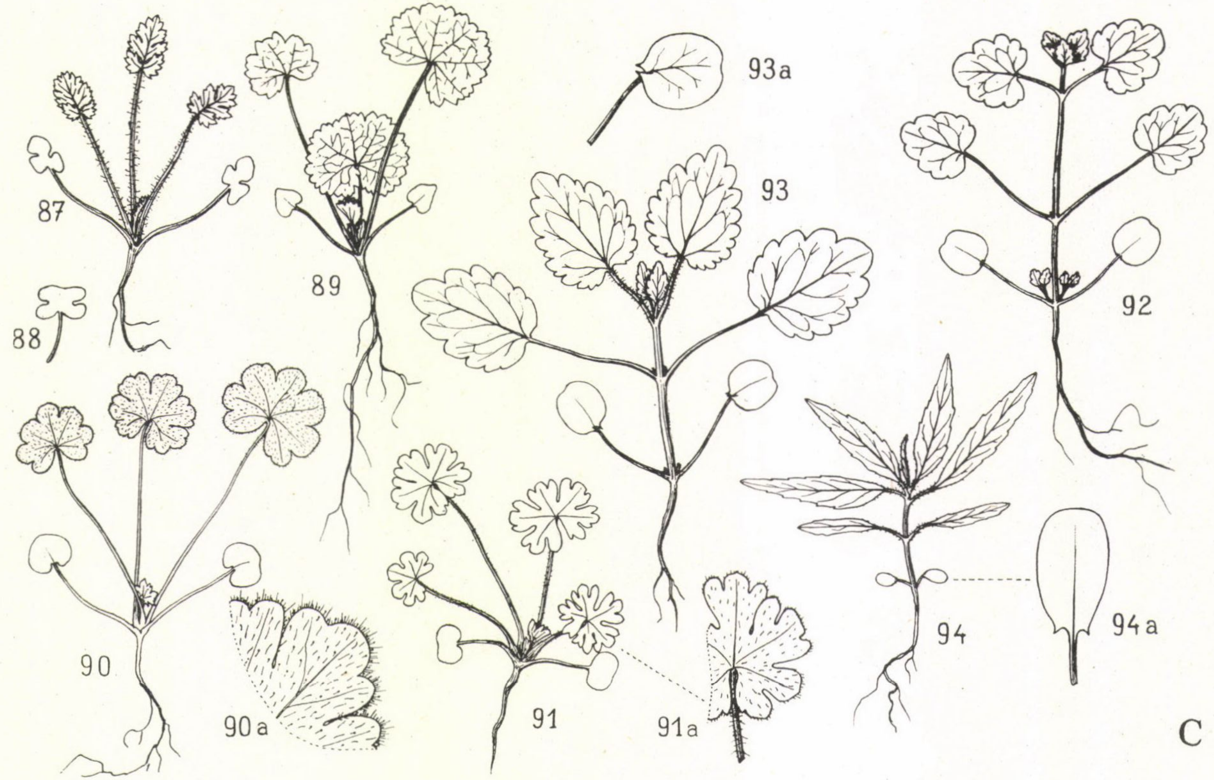

Plate XIII. 87 — *Erodium cicutarium;* 88 — *Geranium divaricatum;* 89 — *Malva pusilla;* 90, 90a — *Geranium pusillum;* 91, 91a — *Geranium dissectum;* 92 — *Lamium amplexicaule;* 93, 93a — *Lamium purpureum;* 94, 94a — *Galeopsis angustifolia*

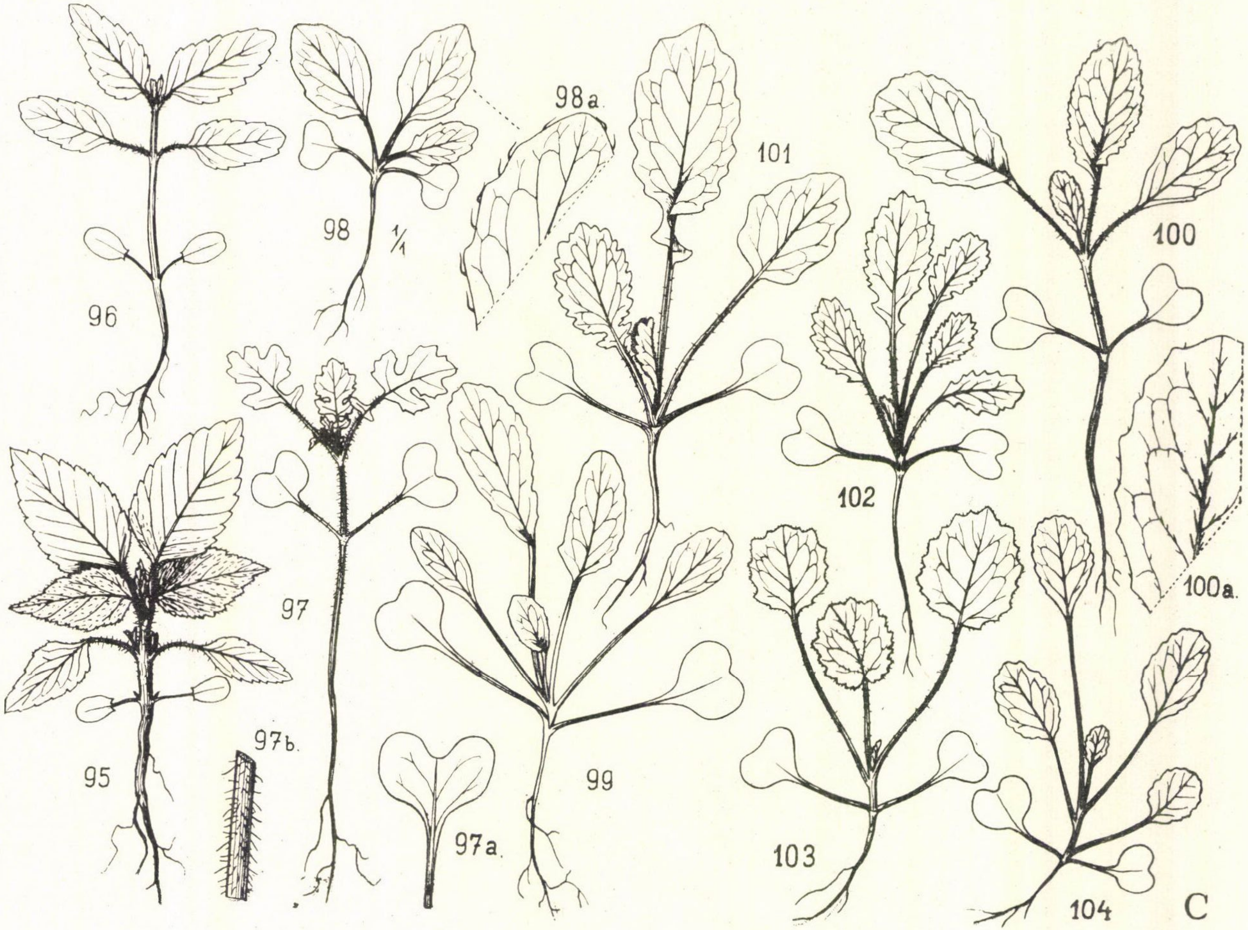

Plate XIV. 95 — *Galeopsis pubescens*; 96 — *Galeopsis ladanum*; 97, 97a, 97b — *Sinapis alba*; 98, 98a — *Brassica elongata*; 99 — *Eruca sativa*; 100, 100a — *Sinapis arvensis*; 101 — *Raphanus raphanistrum*; 102 — *Brassica nigra*; 103 — *Brassica napus* var. *arvensis*; 104 — *Brassica rapa* f. *campestris*

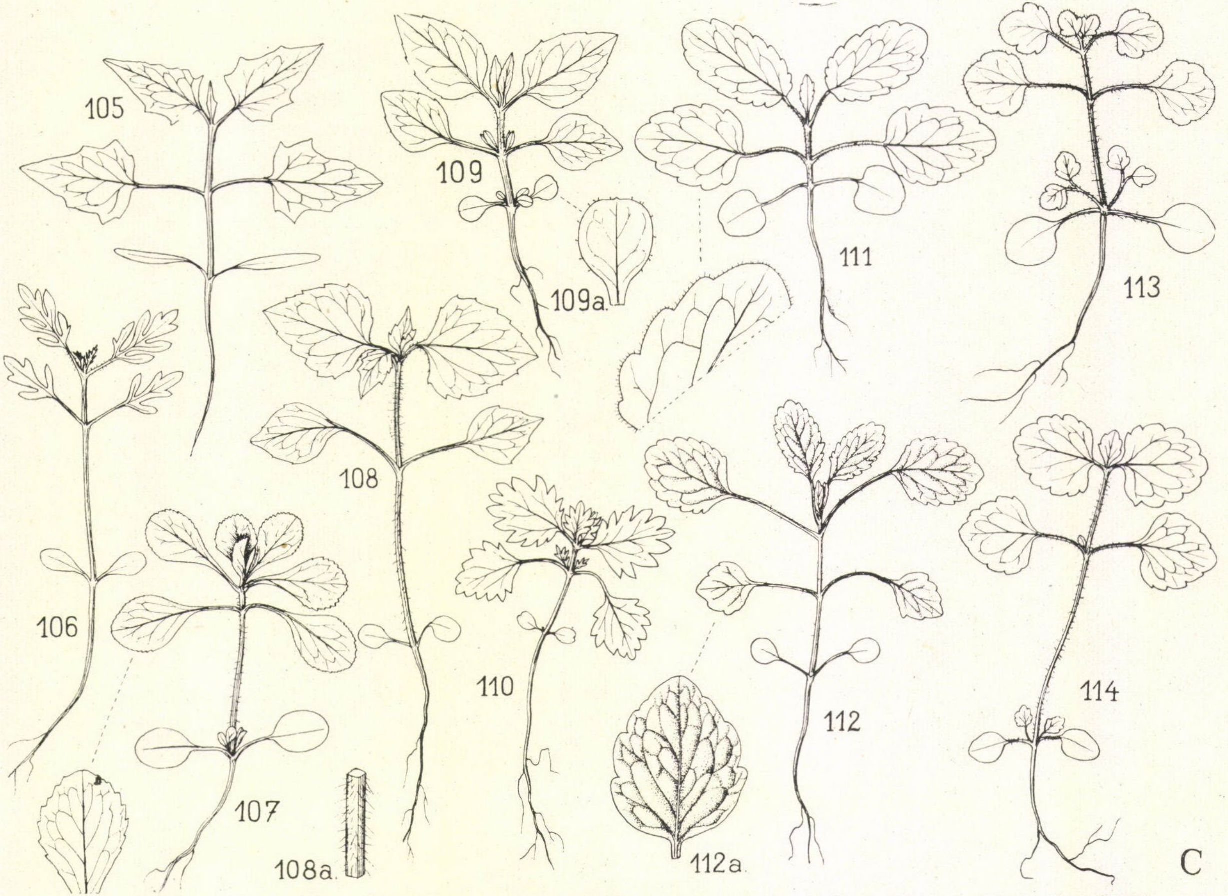

Plate XV. 105 — *Chenopodium hybridum;* 106 — *Ambrosia artemisiifolia;* 107 — *Euphorbia helioscopia;* 108, 108a — *Galinsoga ciliata;* 109, 109a — *Galinsoga parviflora;* 110 — *Urtica urens;* 111 — *Scrophularia scopolii;* 112, 112a — *Stachys annua;* 113 — *Veronica hederifolia;* 114 — *Veronica persica*

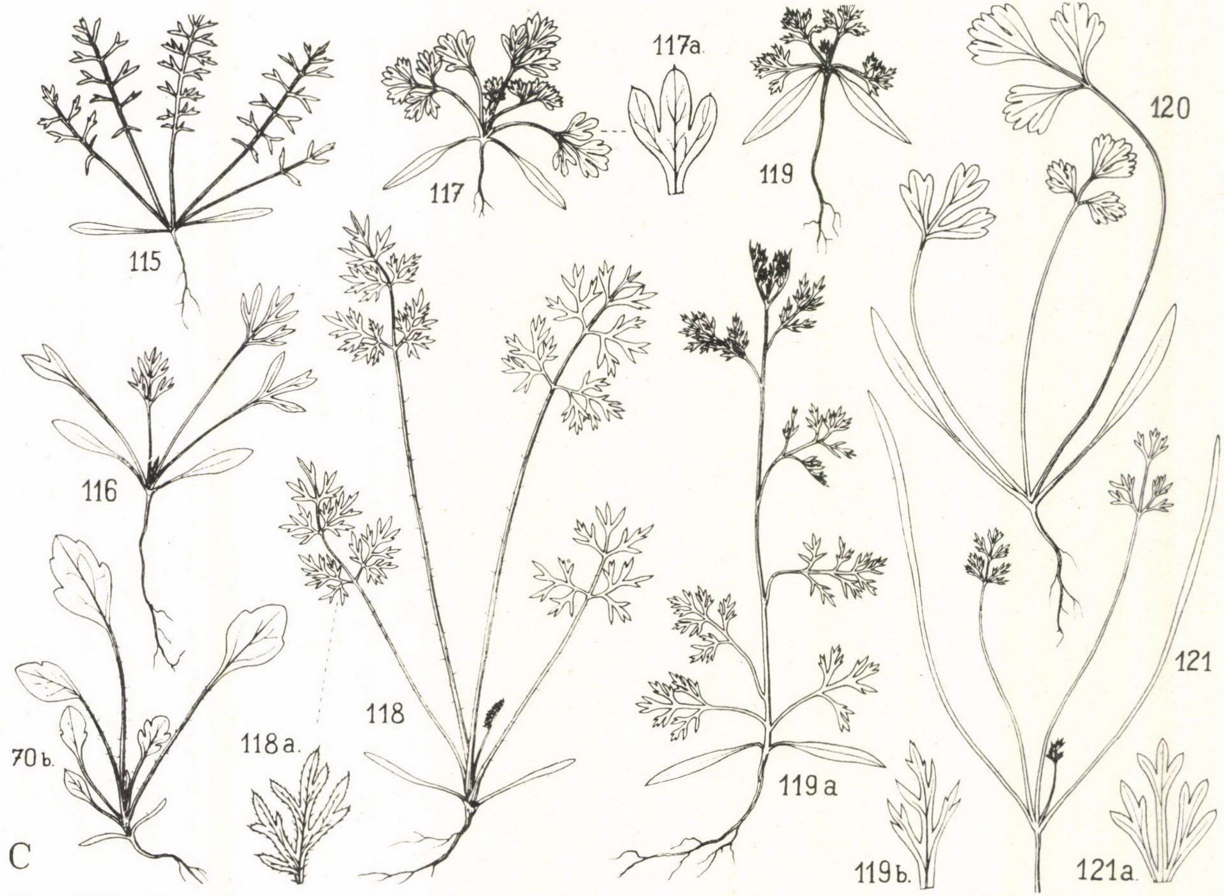

Plate XVI. 115 — *Lepidium perfoliatum*; 116 — *Nigella arvensis*; 70b — *Papaver rhoeas*; 117, 117a — *Fumaria schleicheri*; 118, 118a — *Daucus carota*; 119, 119a, 119b — *Adonis aestivalis*; 120 — *Bifora radians*; 121, 121a — *Scandix pecten-veneris*

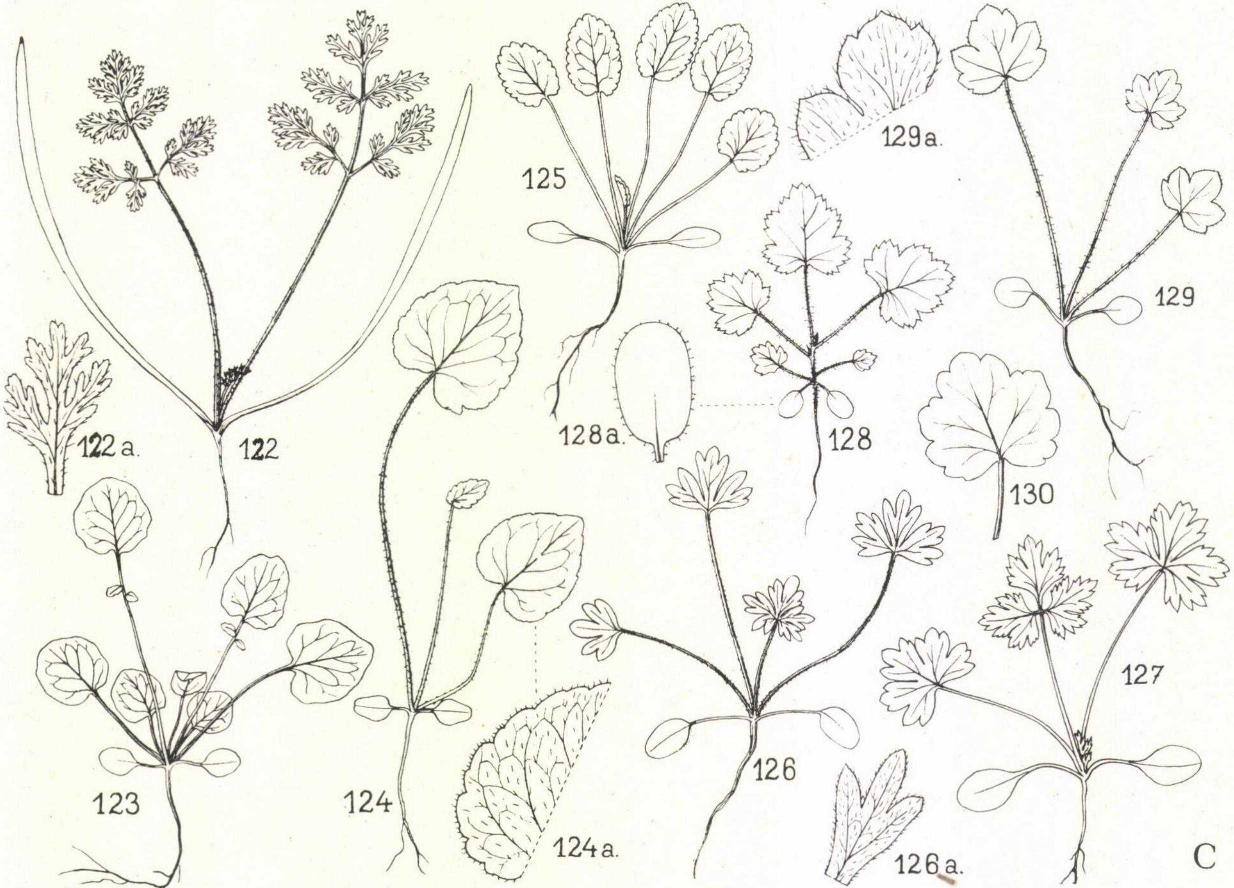

Plate XVII. 122, 122a — *Caucalis lappula;* 123 — *Barbaraea vulgaris;* 124, 124a — *Campanula rapunculoides;* 125 — *Falcaria vulgaris;* 126, 126a — *Delphinium consolida;* 127 — *Aethusa cynapium;* 128, 128a — *Rubus caesius;* 129, 129a — *Ranunculus repens;* 130 — *Ranunculus sardous*

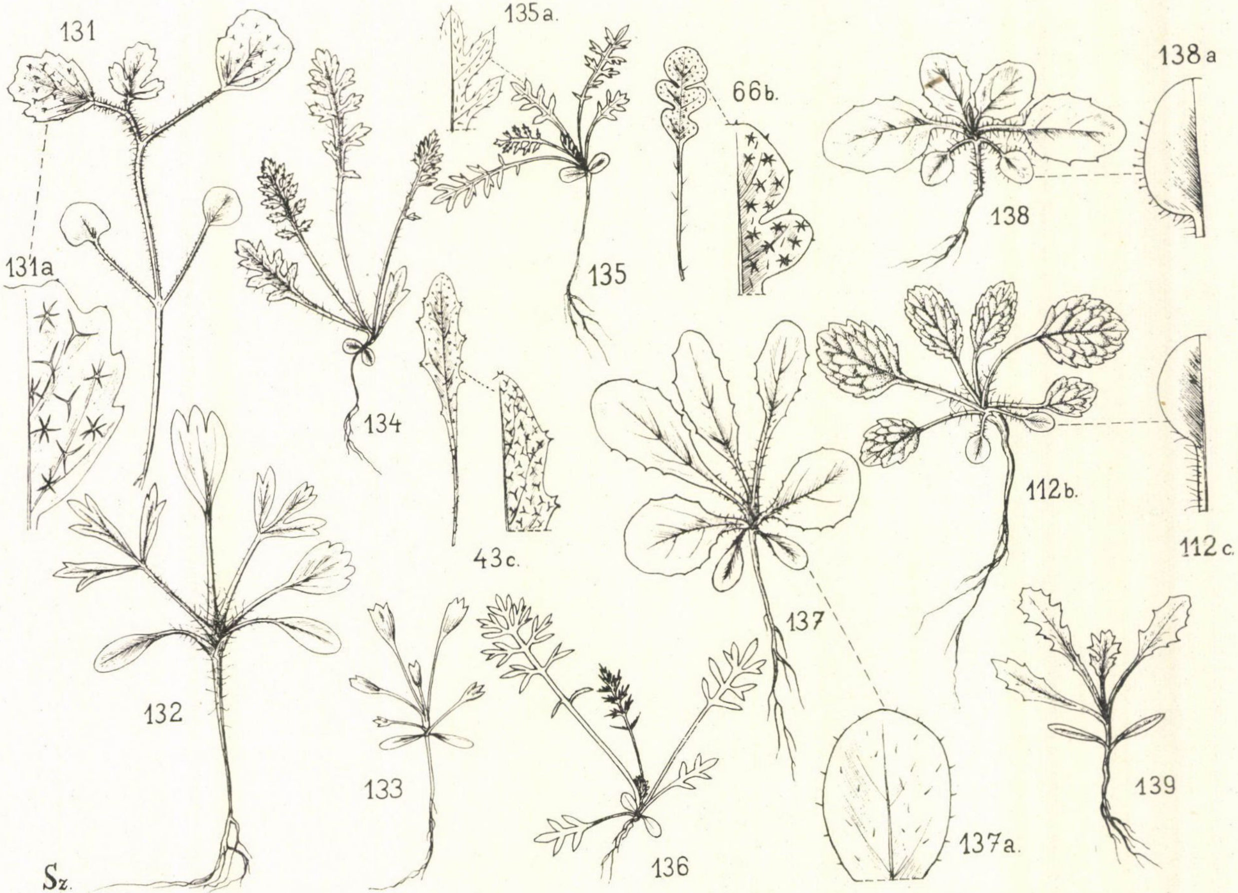

Plate XVIII. 131, 131a — *Hibiscus trionum;* 132 — *Ranunculus arvensis;* 133 — *Glaucium coxniculatum;* 134 — *Achillea millefolium;* 135, 135a — *Anthemis arvensis;* 136 — *Matricaria inodrora;* 43c — *Erysimum repandum;* 66b — *Capsella bursa-pastoris;* 137, 137a — *Lactuca serriola;* 138, 138a — *Kickxia elatine;* 112b, 112c — *Stachys annua;* 139 — *Senecio vulgaris*

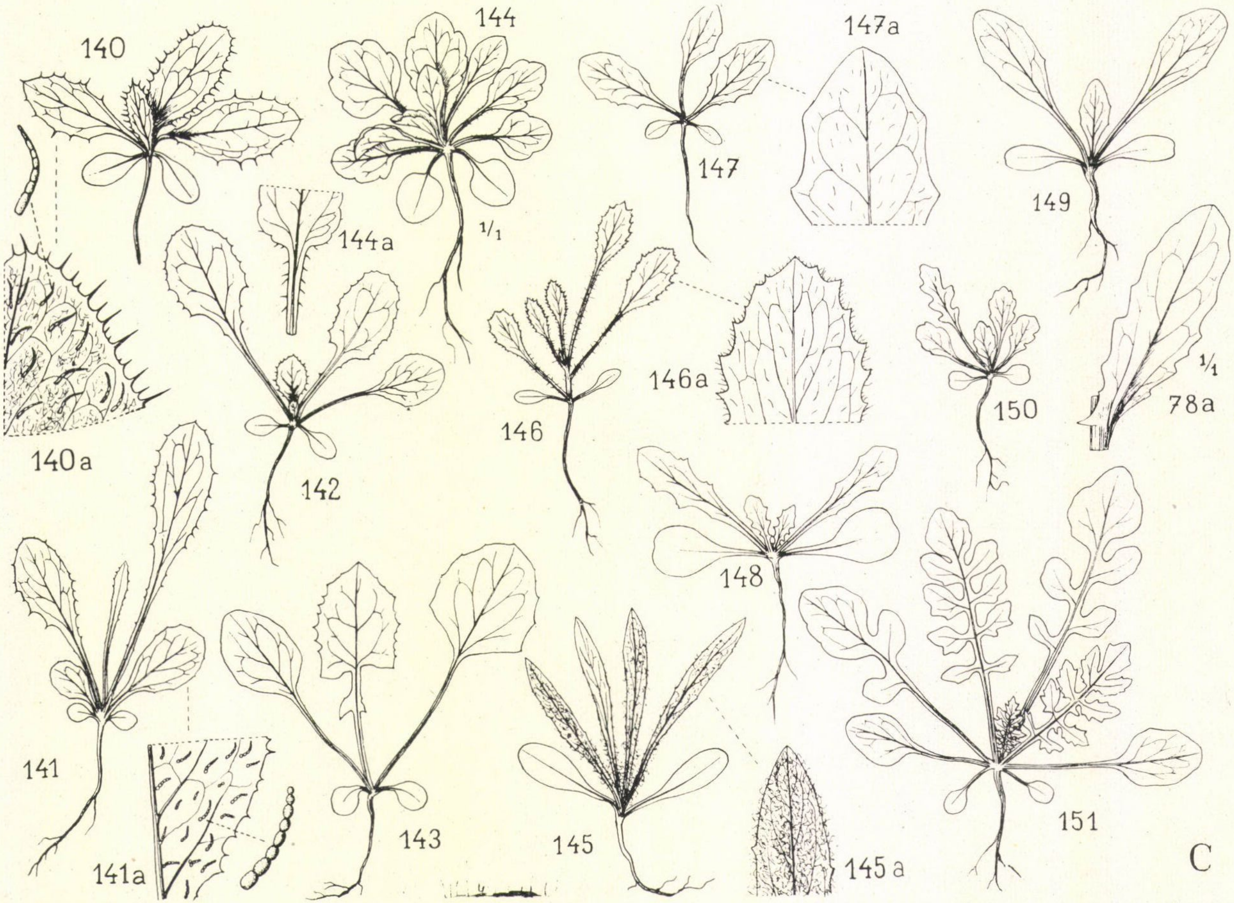

Plate XIX. 140, 140a — *Cirsium arvense;* 141, 141a — *Sonchus arvensis;* 142 — *Sonchus asper;* 143 — *Sonchus oleraceus;* 144, 144a — *Viola arvensis;* 145, 145a — *Centaurea cyanus;* 146, 146a — *Senecio vernalis;* 147, 147a — *Taraxacum officinale;* 148 — *Myagrum perfoliatum;* 149 — *Cichorium intybus;* 78a — *Thlaspi arvense;* 150 — *Diplotaxis muralis;* 151 — *Rorippa silvestris*

INDEX

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ON THE VIABILITY OF SPORES OF CLAVICEPS PURPUREA (FR.) TUL. STRAINS

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The aim of the experiment was to determine the number of spores and germinating power of *Claviceps purpurea* strains stored for 12 weeks at room temperature, further, to study the virulence of strains as well as the amount and total alkaloid content of ergots produced in field experiments.

After 12 weeks the number of conidia decreased by less than 50 per cent only. Decrease in germinating power was not significant after the same period. Field examinations showed no significant differences in ergot yield between the individual strains and the amount of ergots produced proved to be satisfactory.

Introduction

Ergots, sclerotia of *Claviceps purpurea* (Fr.) Tul. developed on rye provide an important pharmaceutical raw material. Collecting wild ergots for pharmaceutical purposes means volumes varying year by year both quantitatively and qualitatively; for this reason — and because of the increasing application of products made of them — production of ergots of uniform quality in large quantities has become necessary.

Artificial infection of rye can be carried out by using ascospores of *Claviceps purpurea* or diluted honey dew or conidiospores cultured on media. When it is a question of producing large volumes of inoculum only the latter can be taken into account.

From 1951 on in Hungary inocula for extensive infections have been cultured on agar media containing malt extract of 8—10 per cent sugar content, according to the method suggested by Békésy (1955). Before 1951 conidia were produced in Petri dishes, from 1952 on in R Kolle bottles suggested by Román (1950).

In practice spores developed on the surface of agar medium were washed in water and used for inoculation. Cultures should be made within 3 months before inoculation, because aged spores are not suitable for infection. Dim-Zajec (1951) found cultures no older than 4 weeks to be the most suitable for infecting ryes. Apart from this no literature referring to the preparation and storability of inocula is available. In Hungary there is an interval of 12 weeks between preparation and application of inocula, therefore our investigations have aimed at selecting strains with the highest number of spores from stock cultures received from the Gyógynövény Kutató Intézet (Medicinal Plant Research Institute) for the purpose of producing inocula. Changes in the number of spores and germinating power of strains cultured on agar at room temperature for 12 weeks have been studied. Finally, virulence of strains, amount and alkaloid content of ergots produced have been studied in field experiments.

Materials and Methods

The experiments have been carried out by using separately analysed ergotamine-, ergocristine- and ergotoxin strains received from the Gyógynövény Kutató Intézet (Medicinal Plant Research Institute) M. Békésy scientific section leader for the ergot production of 1967. Cultures were produced by inoculating sterile pieces of the inner pseudo-parenchyma tissue of sclerotia onto agar medium. Strains giving the highest number of conidia were selected from the test-tube cultures by counting the spores. These were propagated on malt-agar medium in R Kolle bottles. 2.5 cm^3 inoculum with a content of about 5000 conidia per mm^3 was used for inoculating the surface. The ergotamine strains were marked with: *Ta*, the ergocristine strains with: *Kr*, and the ergotoxin strains with: *Tox.*

The number of conidia was determined in Bürker chamber by diluting the content of one R Kolle bottle in 1000 ml water. The conidium number is the arithmetical mean of conidia developed on 3 R Kolle bottles surfaces. Agar cultures taken out of the R Kolle were mechanically mixed for 5 minutes then determined for conidium number in Bürker chamber. Numbers obtained in Bürker chamber showed $\pm 5-15$ per cent deviation according to our experiences.

The germinating power of conidia was determined: a) by the germinative ability at 27° C in suspension and b) by the Kybal (1955) method on agar surface. With an amendment made by us latter consists of the following: 3 per cent agar was added to a medium containing 1 per cent malt-extract; after having been boiled to pulp the medium was sterilized at a pressure of 1.5 atm for 10 minutes. After sterilization media were pipetted into Petri dishes of 10 cm diameter, 15 ml each. Petri dishes thus prepared were stored in a refrigerator at +2° C for 4 days, then dried at 37° C. On the fifth day the Petri dishes were inoculated by the following way: the content of each R Kolle bottle was mixed mechanically in $^1/_2$ l sterile water and 10-fold and 100-fold dilutions were made of them. 200 γ/ml penicillin and 200 γ/ml Streptomycin were added to the diluting physiological water. 1 ml of each of these diluted suspensions was transferred to the agar surface. Each dilution was distributed and spread evenly on the surfaces of two Petri dishes, then cultured at 28° C for 36 hours. Germinating power of conidia was determined microscopically after 24 and 36 hours by counting 20—20 visual fields crosswise and taking the mean.

Small plot field experiments were carried out in the spring of 1967 at Rákoskeresztúr, in plots of $5 \times 6 = 30$ m^2, in the middle of the 40 cad. yoke rye field of the "Összefogás" cooperative farm. The experiments were arranged in latin squares by SARKADI's method (1962) in 4 replications with the following treatments:

control (inoculum made of the mixture of the 8 ergotamine strains cultured on agar)
stock No. 44. (Ta)
stock No. 43. (Ta)
stock No. 12. (Ta)
stock No. 14. (Ta)
stock No. 42. (Ta)
stock No. 19. (Ta)
stock No. 9. (Ta)
stock No. 45. (Ta)
stock No. 80. (Kr)
stock No. 92. (Tox)

Inoculations were reported by BÉKÉSY (1955) to have been carried out on the 4th May 1967, when ear tips of the rye emerged from the leaf sheaths.

Spore suspension used for inoculation was made by a mechanical mixing of the content of 2 R Kolle bottles per treatment for 5 minutes, then diluting it to 5 l. Inoculation was carried out by hand after the method of Blazek *ei al.* (1953).

Ergots produced in field plots were collected with harvesting aprons according to Andruskó's method (1956).

Results

Changes in the number of conidia in 12 weeks are shown in Fig. 1, while numerical data are presented in Table 1. Both of them show that inocula made on agar media can be stored for 12 weeks then used for field infection, as no more than 50 per cent decrease in the number of conidia has ever occurred.

The germinating power of conidia was determined by Kybal's method (Kybal 1955), as it was found better than the suspension preparation. Percentage germination is presented in Table 2. It shows that ergot inocula can be stored at room temperature for 12 weeks without germinating power being significantly affected. Two conclusions can be drawn from the field experiments on virulence.

Table 1

Changes in the number of conidia in 12 weeks
(Percentage)

Marks of strains	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Stock No. 44. (Ta)								100	92	90	90	90
,, No. 43. (Ta)									100	96	86	86
,, No. 12. (Ta)									100	77	77	87
,, No. 14. (Ta)								100	96	70	70	67
,, No. 42. (Ta)								100	73	65	65	65
,, No. 19. (Ta)							100	70	70	70	70	70
,, No. 9. (Ta)							100	77	77	77	77	77
,, No. 45. (Ta)						100	93	93	94	93	93	92
,, No. 80. (Kr)										100	87	87
,, No. 186. (Kr)										100	81	81
,, No. 92. (Tox)								100	78	77	76	75
,, No. 141. (Tox)						100	94	96	94	94	94	94

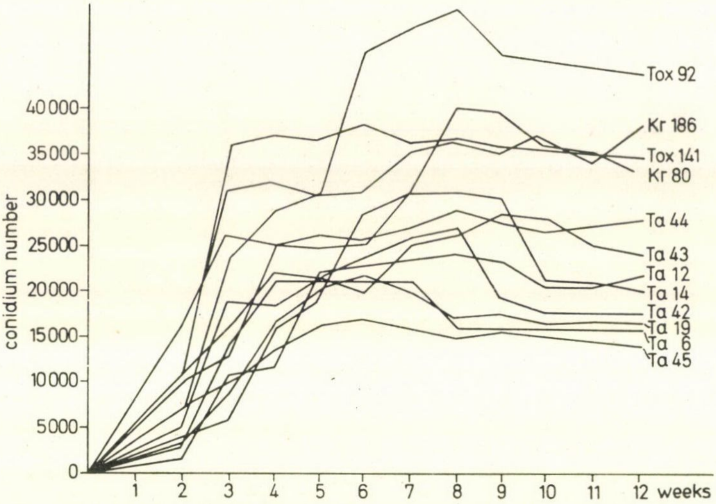

Fig. 1. Changes in the number of conidia of various strains

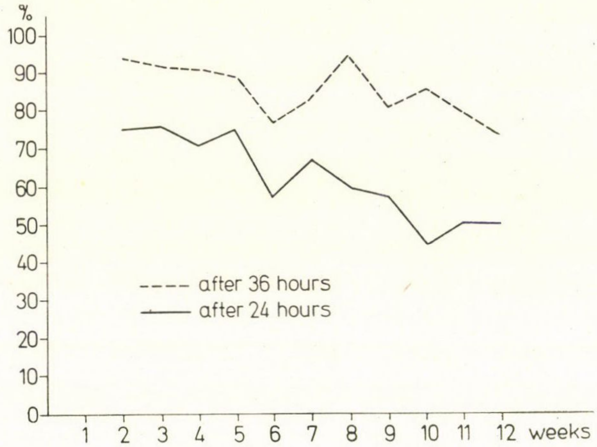

Fig. 2. Germination of conidia

1. No significant differences were found between individual strains used in the experiments as compared to the control made by mixing the strains.

2. The amount of ergots produced in rye plots infected with inocula made of different strains and applied 10—12 weeks later proved to be satisfactory (Table 2). No significant difference between total alkaloid contents is shown. Secondary infections beyond 1 m around the experimental field were not observed.

Table 2

The amount of ergots produced in rye plots infected with inocula made of different strains

Treatments and marks of strains	Culturing		Inoculation		Susp. conidium number used for inoculating rye 1000/mm³	Yield			Total alkaloid content mg/g
	method	date	date	place		kg/cad. yoke (=1.42 acres)	kg/ha.	Ratio when control is 100%	
Control	agar surface	10. III. 1967.	4—5. V. 1967.	Rákoskeresztúr	20 900	80.64	140	100	2.77
Stock No. 44. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		31 800	73.48	127	90	2.85
Stock No. 43. (Ta)	agar surface	17.II. 1967.	4—5. V. 1967.		21 400	76.99	133	95	2.49
Stock No. 12. (Ta)	agar surface	17.II. 1967.	4—5. V. 1967.		31 600	84.04	145	103	2.68
Stock No. 14. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		19 800	73.92	128	91	2.61
Stock No. 42. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		17 200	73.68	127	90	2.63
Stock No. 19. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		23 200	77.13	133	95	2.76
Stock No. 9. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		24 400	83.08	144	102	2.62
Stock No. 45. (Ta)	agar surface	17. II. 1967.	4—5. V. 1967.		24 000	82.70	143	102	2.83
Stock No. 80. (Kr)	agar surface	17. II. 1967.	4—5. V. 1967.		39 800	63.28	113	80	2.78
Stock No. 92. (Tox)	shaken culture	17. II. 1967.	4—5. V. 1967.		25 000	81.14	141	100	2.83

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SYMPTOMS EVOKED BY DIFFERENT STRAINS OF POTATO VIRUS Y ON NICOTIANA SPECIES RESISTANT TO PERONOSPORA TABACINA ADAM

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Infectivity test carried out using 22 isolates of potato virus Y (PVY) belonging to four strains [strain C, PVY^C; normal strain, PVY^N; veinal necrosis strain ("Tabakrippenbräune"), PVY^R and anomalous strain, PVY^{An}] has showed that of the *Nicotiana* species resistant to *Peronospora tabacina* Adam (PtA), *Nicotiana debneyi* Domin, *Nicotiana exigua* Wheeler, *Nicotiana goodspeedii* Wheeler, *Nicotiana megalosiphon* Heurck et Muell. and *Nicotiana tabacum* L. 'Resistant Hicks' are susceptible to PVY. For differentiating the individual strains especially *Nicotiana debneyi* Domin. and *Nicotiana tabacum* L. 'Resistant Hicks' have been found to be reliable test plants. On *Nicotiana debneyi* Domin. isolates of the strains PVY^N and PVY^{An} have produced diffuse mosaic, leaf distortion, retardation of plant growth and leaf curl, whereas PVY^C and PVY^R strains have induced mosaic symptoms. Isolates belonging to the strains PVY^C and PVY^N could be separated on *Nicotiana tabacum* L. 'Resistant Hicks', these isolates have caused vein clearing and vein banding whereas PVY^R and PVY^{An} strains vein clearing, vein banding as well as vein necrosis and stem necrosis.

Introduction

It is known that tobacco (*Nicotiana tabacum* L.), on account of its susceptibility to different virus species, is considered as one of the most suitable test plants in virus research. Previous papers have shown that *Nicotiana tabacum* L. 'Samsun', *Nicotiana tabacum* L. 'White Burley' and *Nicotiana glutinosa* L., are suitable hosts of potato virus Y (PVY). However, the above mentioned tobacco species are susceptible to blue mold, *Peronospora tabacina* Adam (PtA). According to investigations carried out in recent years, *Nicotiana alata* Link et Otto, proved to be one of the best test plants of potato virus X (PVX) and PVY (Horváth 1962, 1964). According to recent results this is one of the most susceptible host plants of PtA (Comes—Ene 1963). Owing to the enormous spreading of PtA (Kröber—Bode 1960, Klinkowski—Schmiedeknecht 1960, Corbaz 1961, 1964, Berger 1962, Tuboly 1962, 1965, 1966 and others) an increased attention has been given to *Petunia hybrida* Vilm. which is suitable for the differentiation of this isolate of PVY (Brandes 1964). *Physalis floridana* Rydb. is known to be a proper test plant both for identifying PVY (Ross 1948, Hutton—Peak 1952 and others) and for producing antisera (Hamann 1961). Despite the fact that the host spectrum of

PVY is rather broad it seems that the importance of tobacco hosts susceptible to PtA and having a number of advantageous properties, are still used in plant virus work. Undoubtedly, the results of experiments on maintaining plant pathogenic viruses (McKinney 1947, McKinney *et al.* 1965, Delevic 1963, Horváth 1966 a, b, c and others) contributed thereto. The basic problem, emerging with susceptible greenhouse test plants, when epidemics of PtA break out, can be solved only by the use of PtA resistant tobacco plants. Recent efforts to increase the resistance to PtA have been highly succesful and have made it possible to produce some resistants (*Nicotiana excelsior* Black, *N. exigua* Wheeler, *N. goodspeedii* Wheeler, *N. gossei* Domin, *N. ingulba* Black, *N. megalosiphon* Heurck et Muell., *N. rotundifolia* Lindl., *N. tabacum* L. 'S 390/1' and *N. tabacum* L. 'Resistant Hicks') as well as immune species (*Nicotiana debneyi* Domin.) and hybrides, respectively (cf. Ternovsky—Daskeeva 1963, Comes—Ene 1963, Berger 1964, Reisch 1964, 1965, Jermoljev—Chod 1964 and others). As a consequence of the results obtained in the breeding for resistance to PtA a growing interest has been shown to tobacco plants resistant to PtA and in recent years it could be demonstrated that some of them are suitable for identifying PVY and PVX (Hein—Bartels 1963, Schmelzer 1964, Jermoljev—Chod 1964, Horváth 1962, 1964 and others). On the other hand, some tobacco hybrids, resistant to PtA, have been found to be resistant also to PVY^R (cf. Cantillon 1966). Therefore it seemed necessary to test with some well-known PtA resistant tobacco species, in how much resistance to blue mould was linked with that against PVY^R. *Nicotiana debneyi* Domin. is known to be susceptible to PVY. Its use in diagnostic works has been increased especially in consequence of the rapid spread of PtA.

According to recent results *Nicotiana exigua* Wheeler, a tobacco species resistant to PtA has been used so far only for isolating alfalfa mosaic virus (AMV) and another virus that exhibits "yellow net" symptoms and is obtained from European elder, *Sambucus nigra* L. (Schmelzer 1963a, b, 1966).

Nicotiana goodspeedii Wheeler is also a new test plant for identifying viruses. No data are, however, available as to its degree of susceptibility to some important viruses.

Nicotiana megalosiphon Heurck et Muell. belongs also to test plants recently examined (Schmelzer 1963a). Its susceptibility to AMV was established for the first time as late as 1963. It is a particularly suitable host plant for conducting premunity tests with various viruses causing ringspot symptoms (Schmelzer 1963a). Now it is considered as being an important test plant for identifying fruit-tree viruses, too (Kegler *et al.* 1966).

Simultaneously with our experiments Jermoljev—Chod (1964) reported that *Nicotiana tabacum* L. 'Resistant Hicks' was susceptible to PVY and PVX. Tests to be made in the following years must decide upon the question whether or not *Nicotiana* species resistant to PtA will be useful in virus work. The aim of this paper is to make a contribution to solve this problem. Our experiments have been directed towards investigating some *Nicotiana* species resistant to PtA and to observe their reaction to various isolates of PVY.

Materials and Methods

Our tests have been carried out using the same 22 PVY isolates collected from different countries, on which it had earlier been reported (HORVÁTH 1966a, b, c, d, 1967a, b, c, ZSCHÜTTIG—HORVÁTH 1968). These strains were maintained under controlled conditions in *Nicotiana tabacum* L. 'Samsun' plants kept in insect proof cages. The earlier claim according to which *Nicotiana glutinosa* L. is immune to potato virus A (PVA) and can be used for maintaining PVY strains (DARBY *et al.* 1951, EASTON *et al.* 1958) had to be abandoned as *Nicotiana glutinosa* L. proved to be susceptible to PVA (SOMMEREYNS 1959, SCHMELZER 1959, KÖHLER 1960, HORVÁTH 1962, 1964). Isolates were kept in an active state by passage from time to time. The tests[1] were conducted with the following species resistant to PtA: *Nicotiana debneyi* Domin. (a), *Nicotiana exigua* Wheeler (b), *Nicotiana goodspeedii* Wheeler (a), *Nicotiana megalosiphon* Heurck et Muell. (a, c), *Nicotiana tabacum* L. 'Resistant Hicks' (b).

Tobacco seedlings were infected with PVY isolates at the 4 to 6 leaf stage. Infection was carried out using a glass spatula and carborundum (500 mesh) as an abrasive *Nicotiana tabacum* L. 'Samsun' leaves infected with various isolates were ground in a mortar. With each isolate 20 plants were infected in two replications. After inoculation the leaves were rinsed with water. Spraying against vectors was made in the greenhouse using a 0.05 per cent solution of Tinox, a systemic insecticide.

Results

Nicotiana debneyi Domin. has proved to be susceptible to all the 22 PVY isolates. The symptoms were of a mosaic character (Fig. 1), especially pronounced with the isolates Epe, Lü 85 and Rs 188. Symptoms produced by isolate EP of the strain C (PVY^C) have been identical with those caused by the isolates M 3 and Gie of strain PVY^R the agent of tobacco veinal necrosis. The symptoms (diffuse mosaic, leaf distortion, retardation of plant growth and leaf curl) produced by the isolates Adg 43, BdN, Bie, CSW, Ine, Lü 72, Lü 86, PK, PVY-L, PVY-N, PVY-P, PVY-R PVY-W, UM and Von of the normal (PVY^N) strain have been identical with those caused by isolates belonging to the anomalous (PVY^{An}) strain (Table 1).

Symptoms characteristic of PVY^R and PVY^{An} strains on tobacco (*Nicotiana tabacum* L. 'Samsun', *Nicotiana tabacum* L. 'White Burley') such as veinal necrosis and stem necrosis (Fig. 1) could not be observed on *Nicotiana debneyi* Domin.

Infection of *Nicotiana exigua* Wheeler with PVY isolates, has resulted in vein clearing, vein banding and mosaic symptoms together with severe upward rolling and crinkling of the leaves (Fig. 2). Between the various isolates no difference in symptom production could be established. Similarly, it was not possible to demonstrate any symptomatological differences between the strain groups (Table 1).

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[1] For sending test plant seeds thanks are due to Dr. Chr. LEHMANN (a) Gatersleben, Dr. P. BERGER (b) Dresden, Dr. K. SCHMELZER (c) Aschersleben, GDR.

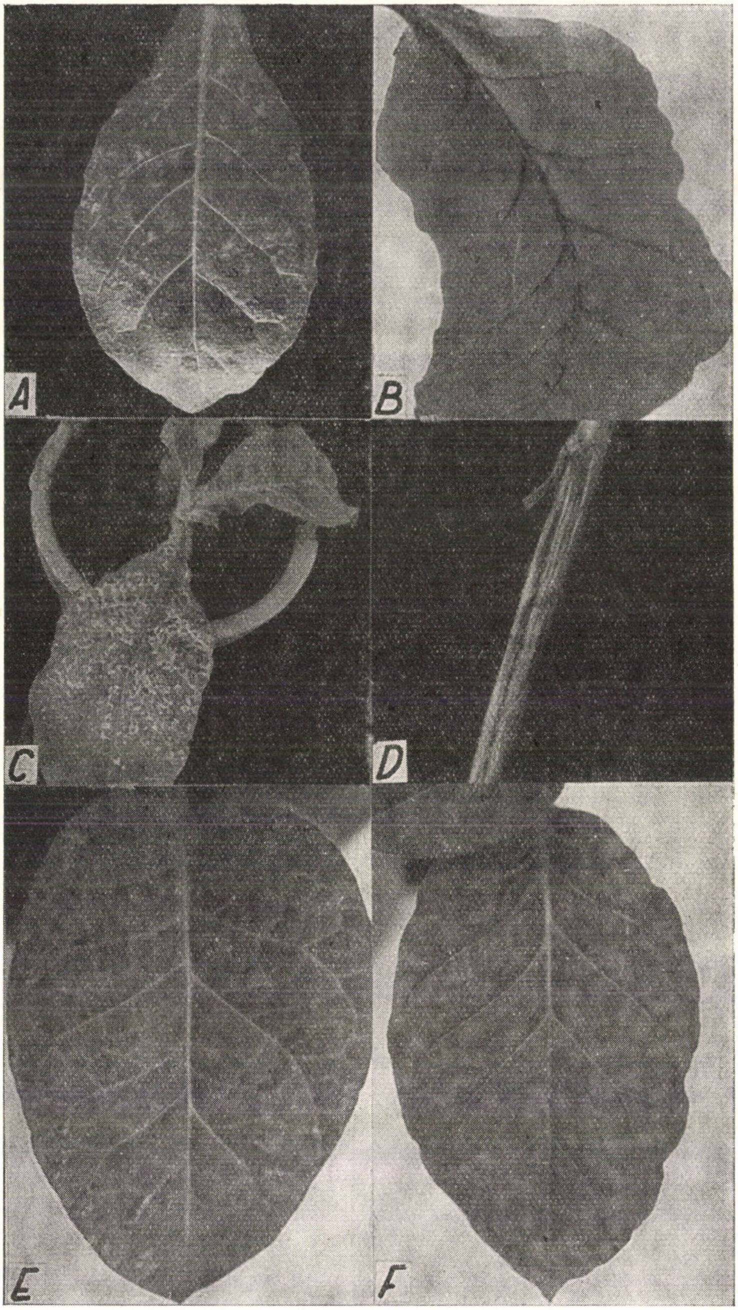

Fig. 1. Plants infected with various isolates of potato virus Y. A: *Nicotiana debneyi* **Domin.** **infected** with isolate PVY-LL. B—F: *Nicotiana tabacum* L. infected with isolates of **potato** virus Y. B: Gie; C: Lü 85; D: Epe; E: PVY-L and F: PVY-LL

Table 1

Symptoms on test plants of potato virus Y strains[1,2]

Test plants	Strains of potato virus Y			
	PVY^C	PVY^N	PVY^R	PVY^{An}
Nicotiana debneyi Domin.	Mo	DifMo, Ld, Rg, Lc	Mo	DifMo, Ld, Rg, Lc
Nicotiana exigua Wheeler	Vc, Vb, Mo, Lur, Lc	Vc, Vb, Mo, Lur, Lc	Vc, Vb, Mo, Lur, Lc	Vc, Vb, Mo, Lur, Lc
Nicotiana goodspeedii Wheeler	Vc, Mo, Lc	Vc, Mo, Lc	Vc, Mo, Lc	Vc, Mo, Lc
Nicotiana megalosiphon Heurck et Muell.	Vc, Mo, Lc	Vc, Mo, Lc	Vc, Mo, Lc	Vc, Mo, Lc
Nicotiana tabacum L. 'Resistant Hicks'	Vc, Vb	Vc, Vb	Vc, Vn, StN	Vc, Vb, StN
Control: *Nicotiana tabacum* L. 'Samsun'	Vc, Vb	Vc, Vb	Vc, Vn, StN	Vc, Vn, StN

[1] PVY^C = Strain C of potato virus Y, PVY^N = Normal strain of potato virus Y, PVY^R = Veinal necrosis ("Tabakrippenbräune") strain of potato virus Y, PVY^{An} = Anomalous strain of potato virus Y.

[2] Mo = mosaic, DifMo = diffuse mosaic, Ld = leaf distortion, Rg = retardation of plant growth, Lc = leaf curl, Vc = vein clearing, Vb = vein banding, Vn = vein necrosis, StN = stem necrosis, Lur = upward rolling of leaves.

Nicotiana goodspeedii Wheeler has exhibited vein clearing, mosaic and leaf curl symptoms upon infection by various PVY isolates (Fig. 2). No difference in the type of symptoms produced by the isolates could be detected and the different strains also brought about similar symptoms (Table 1).

As confirmed by infection tests, *Nicotiana megalosiphon* Heurck et Muell. was susceptible to various PVY isolates and proved to be very useful for identifying this virus. It reacted with vein clearing and mosaic symptoms (Fig. 2) followed by leaf curl. From the point of view of identification it has the valuable property of producing very marked symptoms following infection with highly virulent PVY isolates. Particularly severe symptoms have developed as a result of infection with the isolates Epe, Gie, Lü 85, PVY-L, PVY-N, PVY-R and PVY-W. As far as symptoms are concerned no difference could be established neither for the isolates nor the strains (Table 1) used.

When our tests were performed, JERMOLJEV—CHOD reported simultaneously (1964) their finding that *Nicotiana tabacum* L. 'Resistant Hicks', which is resistant to PtA was susceptible to PVY. At the same time they pointed out that in their tests the rate of infection was rather low. Contrary to this statement we got in our experiments a fairly high percentage of infection. The rather quickly growing leaves of this tobacco variety reach a considerable size and are

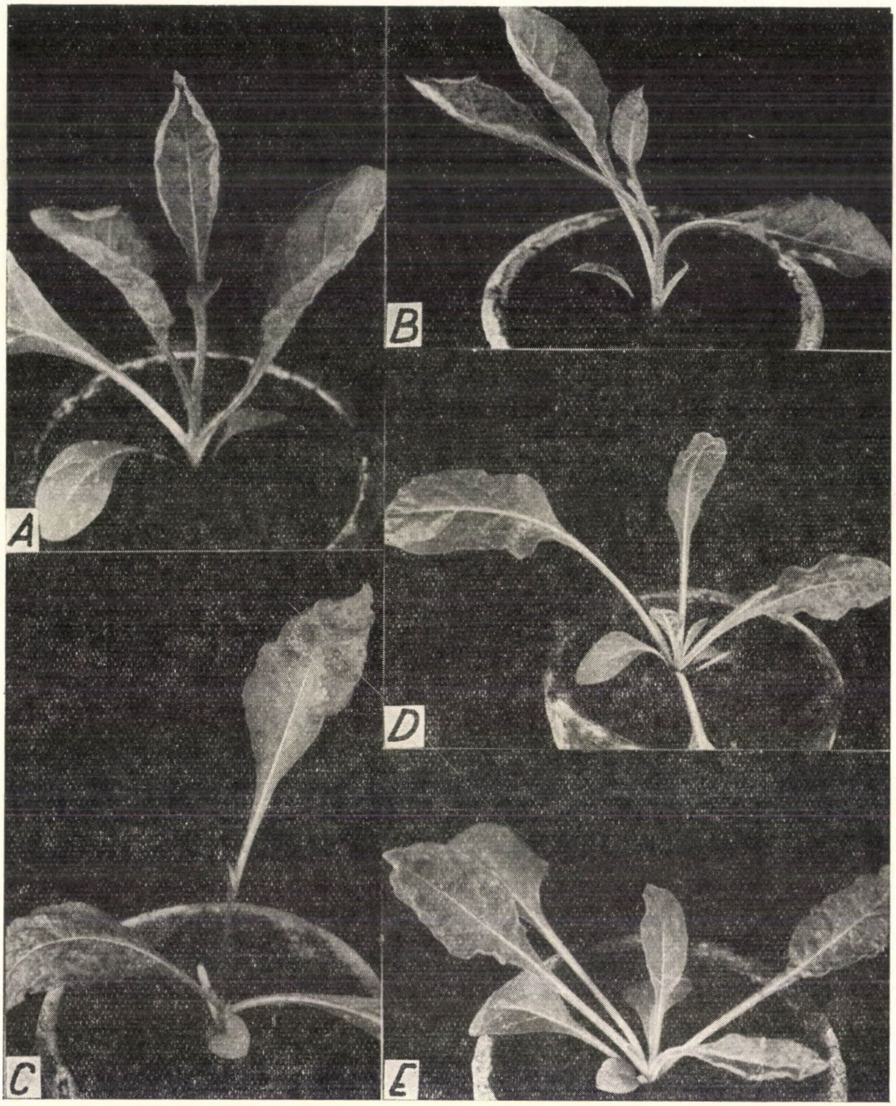

Fig. 2. Nicotiana exigua Wheeler (A—B), *Nicotiana goodspeedii* Wheeler (C) and *Nicotiana megalosiphon* Heurck et Muell. (D—E), infected with potato virus Y isolates. A—B: PVY-P; C: PVY-P; D: PVY-L and E: PVY-LL

suitable for infection like those of other tobacco species resistant to PtA, such as *Nicotiana exigua* Wheeler, *N. goodspeedii* Wheeler, and *N. megalosiphon* Heurck et Muell. Its additional advantage is that the strains PVY^R and PVY^{An} can be differentiated on it from the strains PVY^C and PVY^N on the basis of symptom differences (Table 1). PVY^C and PVY^N strains have induced vein clearing and vein banding, whereas with the strains PVY^R and PVY^{An} typical vein necrosis and stem necrosis were experienced in addition to those mentioned above (Fig. 3).

Nicotiana tabacum L. 'Samsun', used as a control in our tests, was easy to infect. Some days after inoculation with viruses belonging to the PVY^C and PVY^N strain groups, this tobacco exhibited vein clearing and vein banding (Fig. 1). Isolates belonging to PVY^R and PVY^{An} strain groups evoked vein necrosis and stem necrosis in addition to the symptoms mentioned above (Fig. 1).

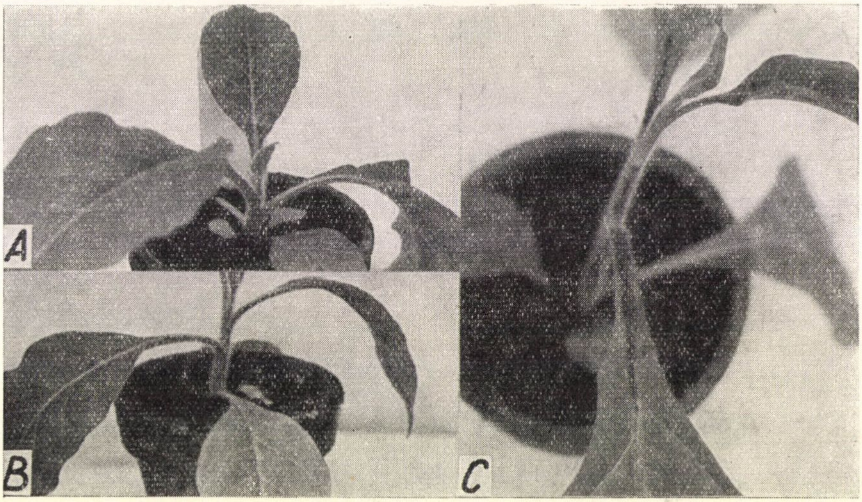

Fig. 3. Nicotiana tabacum L. 'Resistant Hicks' infected with potato virus Y isolates. A: CSW; B: M 3 and C: Epe

Besides slight differences in the symptoms produced by each of the isolates and strains on various tobacco species resistant to PtA there were considerable differences in the duration of the time of incubation and the severity of symptoms. In experiments with tobacco species resistant to PtA on the average of the 22 PVY isolates the shortest time of incubation was found with *Nicotiana tabacum* L. 'Resistant Hicks' and the longest one with *Nicotiana goodspeedii* Wheeler (Table 2). It is worth noting that in the case of *Nicotiana tabacum* L. 'Samsun' used as a control, the average time of incubation of the isolates was slightly longer than that in *Nicotiana tabacum* L. 'Resistant Hicks'. The pathogenicity of the isolates was uniformly low for all the tobacco species tested, i.e. for *Nicotiana debneyi* Domin., *N. exigua* Wheeler, *N. goodspeedii* Wheeler and *N. megalosiphon* Heurck et Muell. The average rates of pathogenicity of the isolates on *Nicotiana tabacum* L. 'Resistant Hicks' were higher and proved to be identical with those on *Nicotiana tabacum* L. 'Samsun'. These data resulted from the fact that symptoms of the strains PVY^R and PVY^{An} on the two latter hosts were similar (Table 2).

Table 2

Time of incubation, pathogenicity, infectivity and severity of symptoms on test plants of potato virus Y isolates

Test plants	Time of incubation in days	Pathogenicity[1]	Infectivity in percentage values	Severity of symptoms[2]
Nicotiana debneyi Domin.	15	30	89	24
Nicotiana exigua Wheeler	16	30	91	29
Nicotiana goodspeedii Wheeler	17	30	84	24
Nicotiana megalosiphon Heurck et Muell.	15	30	87	29
Nicotiana tabacum L. 'Resistant Hicks'	10	27	100	31
Control: *Nicotiana tabacum* L. 'Samsun'	11	27	100	26

[1] The pathogenicity is considered to be high (10) if the time period of the morbid state is less than 45 days, medium (20) if longer than 45 days but shorter than 65 days and low (30) if longer than 65 days.

[2] Weak = 10, medium = 20, severe = 30 and very severe = 40.

Some differences in infectivity of the isolates have been observed on various host plants (Table 2) and except *Nicotiana tabacum* L. 'Resistant Hicks', infectivity was in every case lower than that on the control (*Nicotiana tabacum* L. 'Samsun').

The differences in the severity of symptoms were quite conspicuous for each of the tobacco plants. In Table 2 results obtained for each of the host plants on the basis of the severity of symptoms brought about by the average of the isolates are given. It can be concluded from the experiments that the most severe symptoms were induced on *Nicotiana tabacum* L. 'Resistant Hicks', *N. megalosiphon* Heurck et Muell. and *N. exigua* Wheeler, whereas those produced on Samsun tobacco (control) were less marked. Still weaker symptoms were exhibited by *Nicotiana debreyi* Domin. and *Nicotiana goodspeedii* Wheeler.

Further on, the time of incubation, pathogenicity, infectivity and the severity of symptoms produced on tobacco plants resistant to PtA (Fig. 4 A and B) as well as on *Nicotiana tabacum* L. 'Samsun' (control) (Fig. 4C and D) have also been observed and the results expressed as average values obtained for the plant tested. Our tests have revealed that the average time of incubation for tobacco species resistant to PtA varies from 13 to 16 days, whereas for Samsun (control) tobacco from 10 to 14 days. Determining the degree of pathogenicity of isolates it could be stated that isolates of the strain groups PVY^{C}

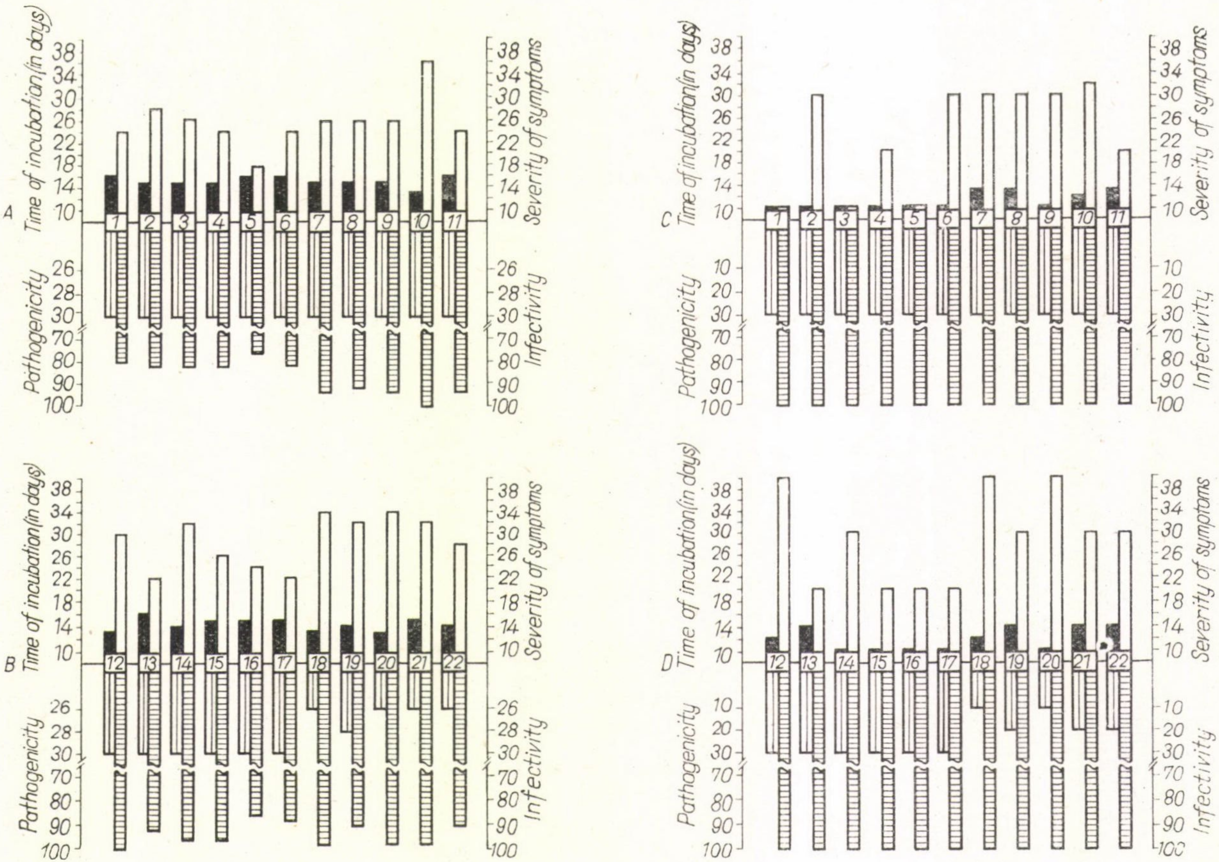

Fig. 4. Incubation period, severity of symptoms, pathogenicity and infectivity of different isolates of potato virus Y on *Nicotiana* species resistant to *Peronospora tabacina* Adam (A and B) and *Nicotiana tabacum* L. 'Samsun' [control (C and D)] upon mechanical transmission. Time of incubation in days = ■, severity of symptoms (weak = 10, medium = 20, severe = 30 and very severe = 40) = □, pathogenicity (severe = 10, medium = 20 and mild = 30, see Table 2) = ▥, and infectivity (in percentage values) = ▤. Strain C = 1, normal strains = 2–17, veinal necrosis (Tabakrippenbräune) strains = 18–19 and anomalous strains = 20–22. Isolates of potato virus Y: 1 = EP, 2 = Adg 43, 3 = BdN, 4 = Bie, 5 = CSW, 6 = Ine, 7 = Lü 72, 8 = Lü 86, 9 = PK, 10 = PVY-L, 11 = PVY-LL, 12 = PVY-N, 13 = PVY-P, 14 = PVY-R, 15 = PVY-W, 16 = UM, 17 = Von, 18 = Gie, 19 = M 3, 20 = Epe, 21 = Lü 85 and 22 = Rs 188

and PVY^N behaved in the same manner both with plants resistant to PtA and with Samsun tobacco. Isolates of the strain groups PVY^R (Gie and M 3) and PVY^{An} (Epe, Lü 85 and Rs 188) have showed more marked pathogenicity on Samsun tobacco than on plants resistant to PtA.

It is worth mentioning that the value of pathogenicity as determined on *Nicotiana tabacum* L. 'Resistant Hicks' was identical with that obtained for Samsun tobacco (cf. Table 2).

The index of infectivity of isolates for plants resistant to PtA — except *Nicotiana tabacum* L. 'Resistant Hicks' — was lower than that obtained for Samsun tobacco. Two isolates (PVY-L and PVY-N), which were very virulent in earlier experiments (HORVÁTH 1966 a, c), exhibited a 100 per cent infectivity. Isolates with weak virulence [(EP and CSW) cf. HORVÁTH 1966 b, c] gave lower values of infectivity than the isolates with severe virulence.

Symptomatological tests showed that isolate EP of the strain group PVY^C produced more severe symptoms on tobacco plants resistant to PtA than on Samsun tobacco. Of the isolates of the strain group PVY^N especially isolate BdN produced more marked symptoms on plants resistant to PtA than on Samsun tobacco. Isolates belonging to the strain groups PVY^R and PVY^{An} exhibited symptoms on plants resistant to PtA similar in severity to those observed on Samsun tobacco. At the same time all the other isolates, except Lü 85, caused slightly more severe symptoms on *Nicotiana tabacum* L. 'Samsun'.

Conclusions

The reaction to plant viruses of tobacco species resistant to PtA has been very little studied so far. To my knowledge only *Nicotiana debneyi* Domin., 'S 390/1' hybrid and *Nicotiana megalosiphon* Heurck et Muell. have proved to be suitable for identifying PVY as yet (HORVÁTH 1962, 1964, SCHMELZER 1964, JERMOLJEV—CHOD 1964). TUBOLY (1966) has reported that it is possible to infect *Nicotiana debneyi* Domin. seedlings with a biotype of PtA recently found in Hungary. It is characteristic of *Nicotiana* species (*N. exigua* Wheeler, *N. goodspeedii* Wheeler and *N. megalosiphon* Heurck et Muell.) of the subgenus *Petunioides* resistant to PtA that they grow rather slowly, shoot out stem quickly and have small leaves which is considered as being an unfavourable property. As to the size of leaves of the *Nicotiana* species mentioned above, the results of observations obtained by the author differ from those reported by GOODSPEED *et al.* (1954). Due to its tropical origin *Nicotiana tabacum* L. 'Resistant Hicks' of the subgenus *Tabacum* has large leaves and disposes over the most important characteristics of a good test plant (cf. HOLLINGS 1956). The results obtained by the author are different from the data reported by JERMOLJEV—CHOD (1964) with *Nicotiana tabacum* L. 'Resistant Hicks'. The percentage of infection for this tobacco variety was identical with the optimum value obtained for Samsun tobacco used as a control. With other species resistant to PtA the time of incubation for the virus isolates tested was higher, whereas their pathogenicity and infectivity was lower as compared to the control (*Nicotiana tabacum* L. 'Samsun'). On *Nicotiana exigua* Wheeler, *Nicotiana megalosiphon* Heurck et Muell. the symptoms were more severe, whereas they were less marked on *Nicotiana goodspeedii* Wheeler plant as compared to those observed on *Nicotiana tabacum* L. 'Samsun'.

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EXCRETION OF VOLATILE OIL BY THE COROLLA IN THE DEVELOPING FLOWER OF VALERIANA COLLINA WALLR.

By

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In our present paper we report on our examinations on volatile oil excreted by the corolla, in the stage of gamophyllic organization and built up of mature cells, respectively. Volatile oil is being excreted not only in the epidermis cells but also in those of the mesophyllum and penetrates through the epidermis cell wall covered by the cuticle into the outside world, without any major resinification. Our examinations include the anatomical characteristics of the corolla epidermis.

Introduction

There are great differences in the way and time of the separation and excretion of volatile oil (resin) in the different organs and tissues of *Valeriana collina.*

In previous publications we have already reported on 3 different volatile oil-bodies excreted in an intracellular way in different zones of the root (R. SZENTPÉTERY *et al.* 1965, 1966, 1967a; SÁRKÁNY *et al.* 1966), as well as on the volatile oil excreted temporarily and in an extracellular way by the protoderm of developing leaves (R. SZENTPÉTERY *et al.* 1967a). Besides the root oil bodies and the entirely different volatile oil excreted temporarily in the protoderm and in the glandular hairs developing from it, *Valeriana* has still another type of volatile oil which is entirely different from the root oil and from the volatile oil to be found in the leaf primordium; it is excreted in the tissues of the corolla, and has an agreeable, strong and aromatic scent comparable to that of the carnation. Surprising as it is, there are no adequate informations about it in special literature, although in regions where the plant grows in large quantities, the whole district is imbued with its strong and agreeable scent at the time of efflorescence. In his work about the volatile oil of *Valeriana* root, HOLZNER-LENDBRADL (1963) refers to the fact that volatile oil is excreted not only by the root but by other organs of the plant, too, producing the strong scent of flowers which can also be found in the glandular hairs of the leaves. As pointed out in our previous publications, our examinations have shown that there exists a difference between the various organs of *Valeriana* not only in the way of volatile oil excretion, but substantial differences can be also found in the chemical composition of the oil, resulting in a different scent of the volatile oil excreted by one or the other tissue region. The next task of our research work will be to specify the qualitative and quantitative differences in the chemical composition of the volatile oil excreted by the different tissue regions.

Material and Method

Test material has been gathered in various phases of development of the corolla, ranging from the start of corolla organization to the withering of the flower. The other organs of the flower were cut out of the corolla under a stereo-microscope, and the corolla was studied partly as a whole and partly in longitudinal sections. In the histochemical examination of oil we have used a toluidine—iodine double staining technique, worked out and applied for the examination of the volatile oil of *Valeriana* root, and specific to volatile oils containing unsaturated bonds.

Results and Discussion

The beginning of flower organization is indicated by five small primordia organized in the receding apical part of the reproductive shoot apex

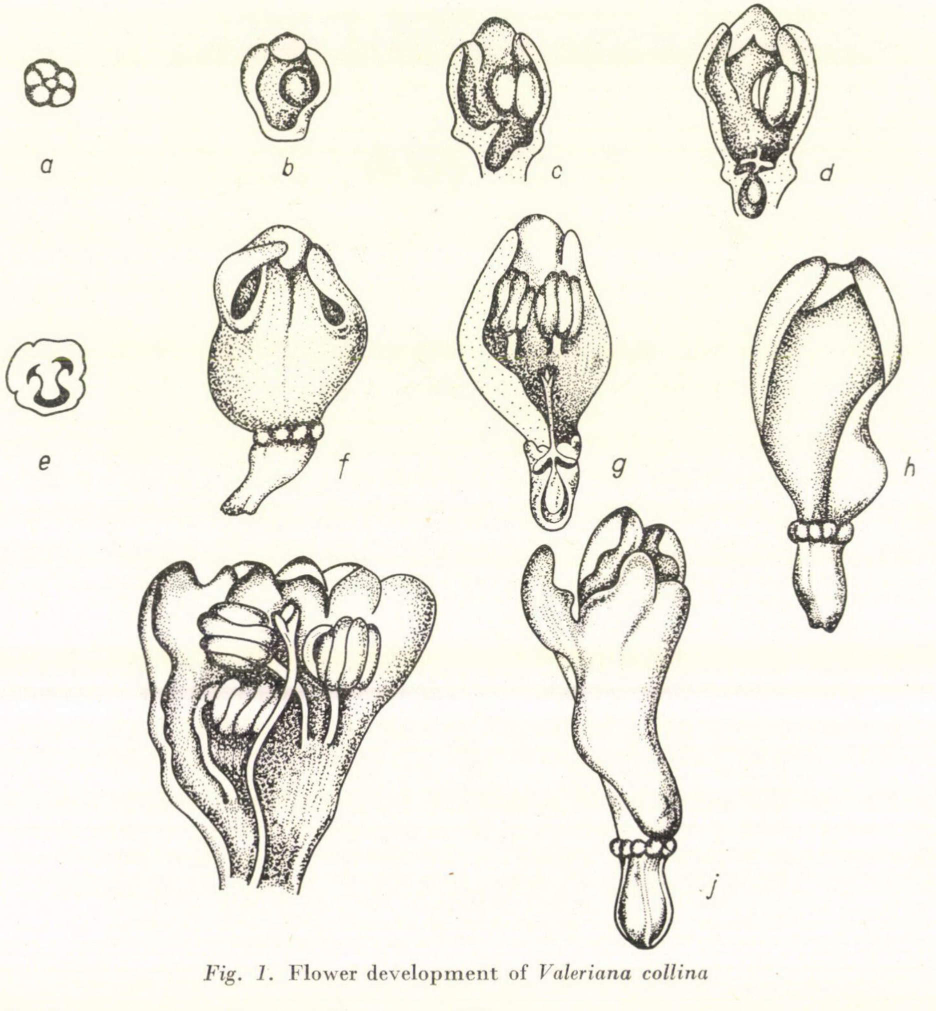

Fig. 1. Flower development of *Valeriana collina*

Fig. 2. Full-blown flower of *Valeriana collina* (19×)

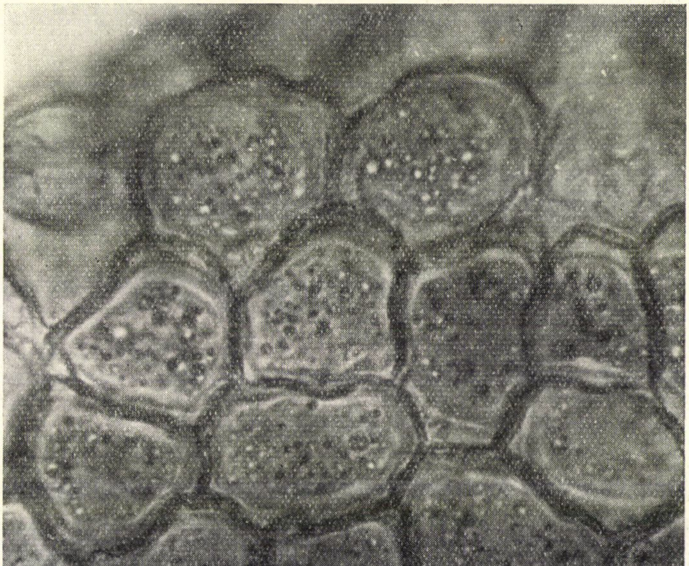

Fig. 3. **Upper side of epidermis of the corolla tube of *Valeriana collina*, toluidine–iodine double staining. N = 40×6.3**

Fig. 4. Lower side of epidermis of the corolla tube of *Valeriana collina*, toluidine–iodine double staining. N = 40×6.3

(R. Szentpétery *et al.* 1962) (Fig. 1a). These primordia are the lobe initials of the corolla developing in a gamophyllic way. The appearance of the lobes is followed by the rapid elongation of the corolla tube (Fig. 1b). In this stage of development the lobes are bending inwards and close the end of the organizing corolla tube, while the development of the anthers begins in the lower third of the corolla. Our examinations on volatile oil formation of the corolla were started in the stage represented on Fig. 1b. By means of toluidine-iodine double staining, fully developed volatile oil could be detected already in this stage in the intensely dividing corolla tube initial. Unlike our examinations with organizing leaves, the precursors could thus not be separated histochemically from the volatile oil containing already unsaturated bonds. Besides the volatile oil taking a characteristic colour precursor droplets having been detected in the leaf could also be observed (R. SZENTPÉTERY *et al.* 1967b). According to literary references, refractive precursor droplets taking no specific colour had been detected in other species, too (AMELUNXEN 1967; PAECH—EBERHARD 1952).

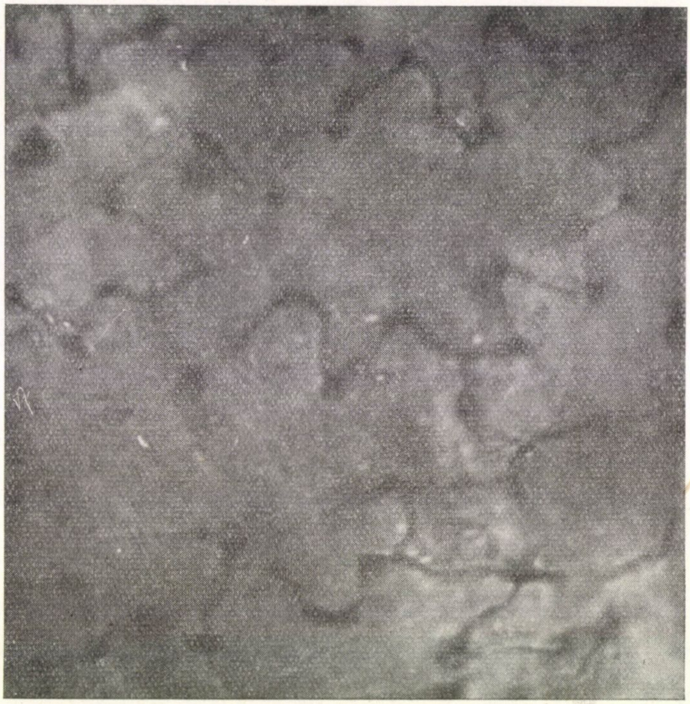

Fig. 5. Thickening of the meandering cells of the lower epidermis of the corolla tube of *Valeriana collina*. N = 40×6.3

In conformity with our investigations, volatile oil formation in the corolla of *Valeriana* begins immediately after the development of the lobe primordian and runs thus parallel to the meristematic activity of the corolla tissues. In works made on inflorescence of *Achillea* and *Matricaria* species, RUMINSKA (1965) has found volatile oil formation to be demonstrable in glandular hairs developing on green and young buds. The formation of volatile oil can be observed throughout the division and elongation of the corolla (Fig. 1b—j). When the corolla is fully developed, much volatile oil can be found both in the epidermis cells and in the cells of the narrow mesophyllum, representing a major difference as compared with the localization to the protoderm of volatile oil formation in developing leaves (R. SZENTPÉTERY *et al.* 1967b). MAZURKIEWITZ (1913 cit. KISSER 1958) has also demonstrated volatile oil formation in the mesophyllum cells adjacent to the epidermis cells of the corolla of several flowers.

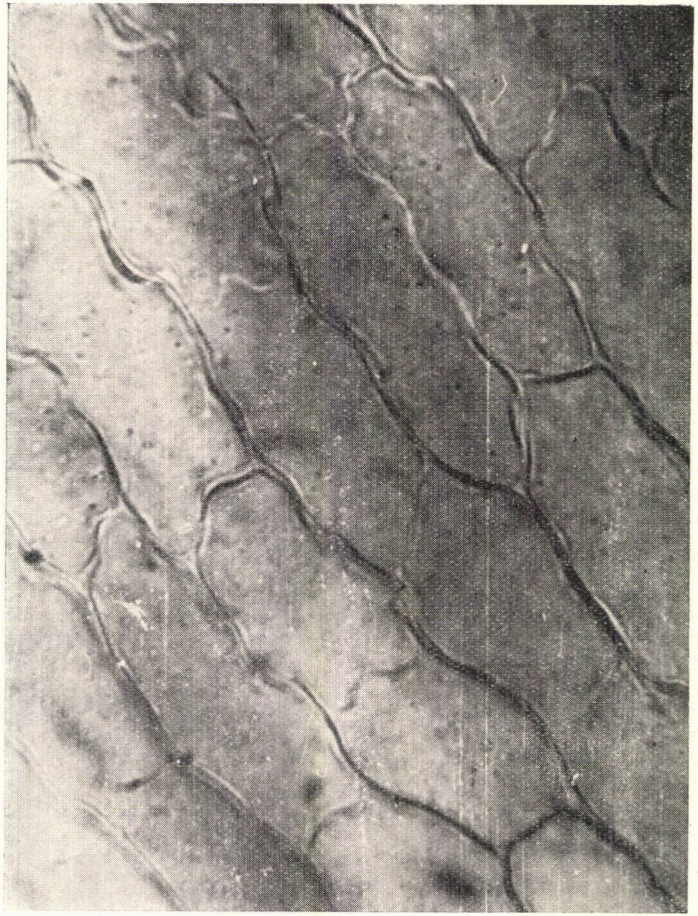

Fig. 6. Epidermis of the basal part of the corolla tube of *Valeriana collina.* N = 40×6.3

Fig. 7. Papillar corolla lobe of *Valeriana collina*, with glandular hair. N = 16×6.3

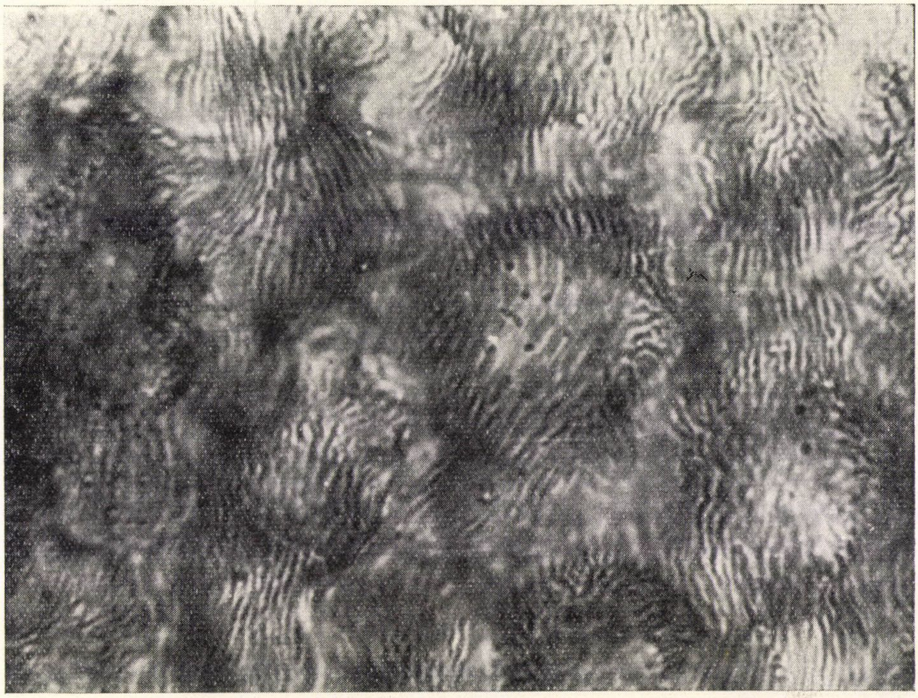

Fig. 8. Cuticle pattern of the lobe papillae of *Valeriana collina.* N = 40×6.3

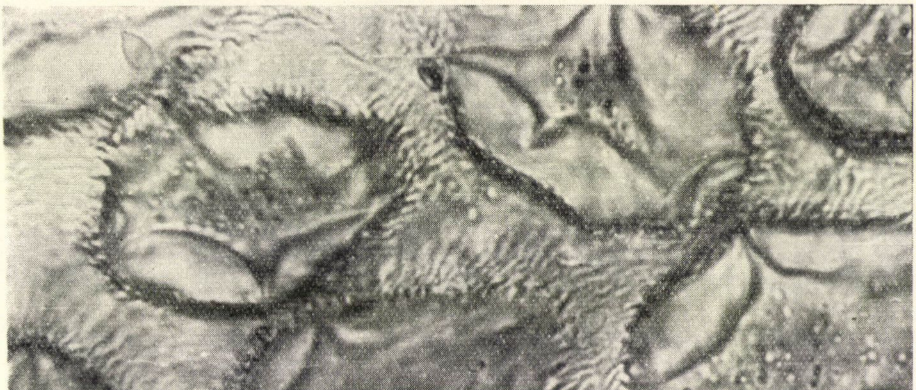

Fig. 9. Plasmolysed papillae of *Valeriana collina.* N = 40×6.3

Fig. 10. Part of corolla lobe with glandular hairs. N = 16 × 6.3

After the full development of the corolla of *Valeriana*, indicated by the stretching out of the lobes (Fig. 2), the formation of further precursor droplets could be observed in addition to the volatile oil droplets, in opposition to what had happened in the epidermis cells of the leaf. Volatile oil and precursor droplets could be detected in the slightly pitted thickened cells of the nearly isodiametric radial walls in the upper epidermis of the corolla tube (Fig. 3), as well as in the cells with meandering walls, elongated in one sense, of the lower epidermis (Fig. 4). In the curves the meandering cell walls are more thickened (Fig. 5). Proceeding towards the basal part of the corolla tube, the cells of the lower epidermis become shorter and their cell walls straighter (Fig. 6). The upper epidermis cells of the corolla lobe are papillar (Fig. 7). A linear cuticle pattern can be seen on the papillae (Fig. 8). Under the action of an intense plasmolysis, the plasm of the papillae contracts in form of a star

(Fig. 9), suggesting the place of development of the plasmodesmata. The precursor droplets do not disappear from the corolla tissues until the flower begins to fade. In opposition to what was found in the developing leaf of *Valeriana*, our investigations have shown that the formation of volatile oil in the corolla is not limited to the meristematic activity of the tissues. There are several references in literature to volatile oil formation in the fully developed corolla of other plants, too (Kisser 1958). Mazurkiewitz (1913, cit. Kisser 1958) has named the continuous volatile oil formation in the perianth a "continuous reformation". The enfleurage technique is actually based on this continuous reformation. In his work on *Mentha piperita* Ahlgrimm (1956) calls our attention to the changes taking place during the efflorescence not only in the quantity but also in the quality of volatile oil. Examinations of *Ruta graveolens* have lead Sprecher (1956) to the conclusion that with the end of growth the formation of oil is also terminated. The formation of other secondary materials in several species have also been localized to young growing cells (Blank 1947; Frey-Wyssling 1943; Paech 1950, 1952, 1954). This finding was absolutely confirmed by our investigations on the organizing leaf of *Valeriana*, since no precursor droplets could be found after cell growth, in fact, the cells entirely

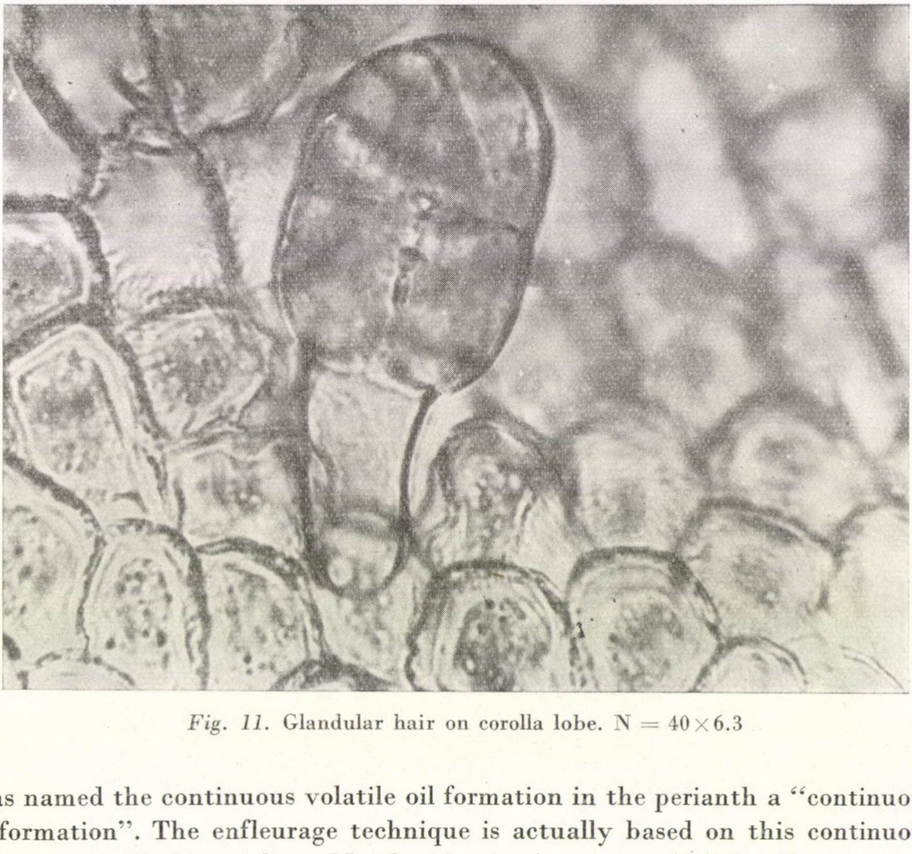

Fig. 11. Glandular hair on corolla lobe. N = 40×6.3

lost their volatile oil contents in the course of aging. However, as shown by our observations of the corolla, the formation of volatile oil limited to the dividing and growing stage of the cells cannot be generalized, since a continuous precursor formation was observed even after the maturity of the cells.

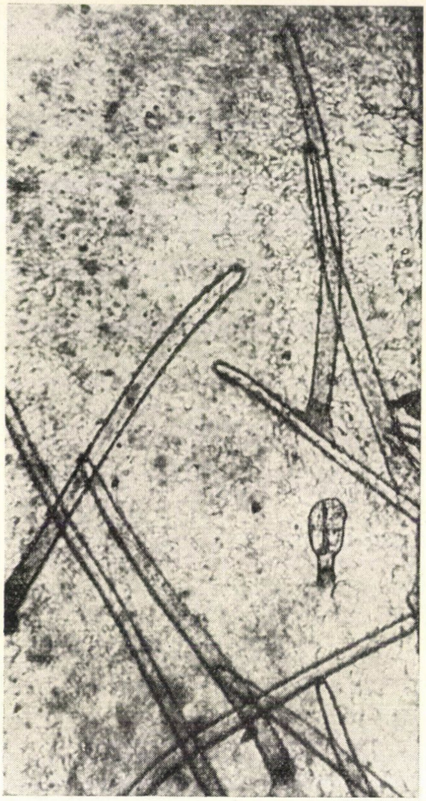

Fig. 12. Upper side of corolla tube of *Valeriana collina* with glandular hairs and unicellular hairs. N = 6.3×6.3

It must be admitted after all that the excretory investigations of plants, while resolving some questions of details, always raise further problems.

As far as volatile oil formation in the corolla of *Valeriana* is concerned we have come to the conclusion that both the precursors and volatile oil are formed in the plasm and penetrate through the cell wall covered with the cuticle, by means of passive diffusion and cuticular transpiration, and then evaporate from the surface of the cell wall. In opposition to what was found on the developing leaf where the volatile oil penetrated through the cell wall became largely resinified, it seems that, in case of the corolla, the volatile oil penetrated through the cell wall does not accumulate and is not resinified as is in the leaf and consequently volatilizes much more easily.

During the development of the perianth, a small number of glandular hairs described already with the developing leaves (Figs 10, 11) and a large number of unicellular hairs with non lignifying cell walls (and therefore not identifiable with the bristles of the leaves) (Fig. 12) are developing on the upper side of corolla and on the lobes. Volatile oil is being excreted both in the glandular hairs and in the young unicellular hairs rich in plasm (Fig. 13).

Fig. 13. Upper side of corolla tube of *Valeriana collina*, glandular and unicellular hairs, with volatile oil droplets. N = 16 × 6.3

Comparing the results achieved so far in studying the various organs of Valeriana collina (R. Szentpétery *et al.* 1965, 1966, 1967a, 1967b; Sárkány *et al.* 1966), we have found that the volatile oil of the corolla differs from that of the root as well as of the developing leaves. In the course of our examinations we have thus detected five different sorts of volatile oil within a single species, as far as the way of excretion and the subsequent conditions of the volatile oil were concerned (in the root: the calyptra oil-body, cortical oil-body, hypodermis oil-body, as well as volatile oil of the developing leaf and the corolla). The fact that there is a great variety within a single species in the time and way of excretion and separation of its secondary substances belonging to the same basic type, i.e., that the cortical and hypodermis oil-bodies of the root remain throughout the vegetation of the plant, while the calyptra oil-bodies get detached together with the calyptra, and the volatile oil excreted by the protoderm of the leaf and by the corolla volatilizes from the surface of the cell wall, — all this again raises the question whether the volatile oils can be generally qualified as excretions or whether the volatile oil produced continuously in certain plant tissues should rather be qualified as secretions according to the role it plays in the vital processes of the plant.

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PARTHENOCARPY INDUCED IN EGG-PLANT (SOLANUM MELONGENA L.)

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As a consequence of a stimulus evoked by pollens got on the pistile of the egg-plant, parthenocarpic fruits and normal ones (i.e. containing seeds) develop from isolated and non-isolated, emasculated and non-emasculated flowers, to different extent, in different years, both when fertilization takes place and when it does not. In case when the pistile is artificially stimulated by touching, only parthenocarpic fruits develop. If the pistile is not stimulated either by pollens or artificially, neither parthenocarpic nor normal fruits develop. Thus, the phenomenon of parthenocarpy is inherited in egg-plants as a predisposition and not as a determined characteristic. Hereditary predisposition is realized by various stimuli affecting the pistile, thus, it is a phenomenon of induced parthenocarpy that occurs in egg-plants.

Introduction

There are two types of parthenocarpic metaxeny or xeny (fruit formation without seeds): natural and induced parthenocarpy. Natural parthenocarpy is a hereditary characteristic, no exogenous effects are required for its development (CRANE 1963, GORTER—VISSER 1958, GUSTAFSON 1939, KARNATZ 1963, KOLESNIKOV 1962, KORDYUM 1963, LAZÁNYI 1957, VONDRACEK 1962, WILSON 1961). In the case of induced parthenocarpy the development of fruits starts as a result of stimuli affecting the pistile (exogenous effect). Such effect can be induced in various plants by GA (BRADLEY—CRANE 1962, CRANE 1963, JACKSON—BLUNDELL 1964, YEVTUSHENKO—POPOV 1964, RAY 1963, SACHAR—KAPOOR 1959, SUGIARA—INABA 1966, WOOD—COLLINS—BARKER 1966, ZATYKO 1962, 1963), by 2,4,5-TP (EL-MAGUIED 1966, PRIMER—CRANE 1957), by N-aryl glycine (TAKEDA—SENDA 1957), quinine (CRANE—VAN OVERBECK 1965), K-gibberellate (EL-MAGUIED 1966), 2,4-D (EL-MAGUIED 1966), further, by isolation (MLADENTSEVA 1963), mechanical stimulation (MLADENTSEVA 1963), alien pollens (MLADENTSEVA 1963, PÁL—OSVALD 1965), removal of the parts of flowers but the pistile (KOLESNIKOV 1962), and by GA or IAA treatments following the removal of male sexual organs (JACKSON—PROSSER 1959). The individual effects may be modified by weather conditions (KARNATZ 1963), but the effect of frost does not induce parthenocarpy (GORTER—VISSER 1958, KARNATZ 1963).

Bailey—Munson (1891) were the first to observe that in egg-plants fruits developed even when fertilization did not take place, and in this case seedless, parthenocarpic fruits were produced. Later it was established (Pál—Osvald 1965) that congenerous pollens and those alien to the species got naturally or artificially on the pistile of the egg-plant resulted in the organization of parthenocarpic fruits, but no unequivocal connection of the degree of relationship between pollen donor and egg-plant with the number of parthenocarpic fruits could be demonstrated. El-Maguied (1966) has obtained parthenocarpic fruits by using various growth regulators; K-gibberellate increased the size of fruits but did not alter their characteristic shapes; 2,4-D and 2,4,5-TP caused abnormal formations in the shape of fruits, too. Total ascorbic acid content of fruits produced under the influence of growth regulators increased significantly.

Material and Method

We have used egg-plants (*Solanum melongena* L.) in our investigations. Within the species of *Solanum melongena* L. according to Filov's system (1958) we examined the following plant: *Solanum melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil., — the common lilac egg-fruit.

Those flowers of the egg-plant in which fruit organization has not started become detached at the base of fruits and together with the stems they drop, while those where fruit organization has started continue to develop. Emasculation was carried out in flower bud stage, when fertilization could not yet occur; they were subsequently isolated with cellophane.

Our field examinations were carried out in 1963—1967, with 50 flowers per combination each year. Fruit development took place under cellophane isolators. Ripe fruits were removed and the extent of fruit set — i.e. the percentage of flowers in which fruit formation took place — was determined. Fruits were examined for their being parthenocarpic or not. Our investigations were extended to the following problems:

1. Whether it is natural or induced parthenocarpy that occurs in the egg-plant.
2. In case of induced parthenocarpy: what is induction evoked by.

Results

Thus, the question is, whether the phenomenon of parthenocarpy observed in egg-plants is a natural i.e. hereditary characteristic or a result of induction. In the latter case, what is organization of parthenocarpic fruits induced by? In our investigations 1. pollens got on the pistile, 2. lack of fertilization, 3. isolation, 4. emasculation, 5. different years and 6. stimuli affecting the pistile — were supposed to be the causes of induction.

Our examinations can be divided into 3 main parts. In the first part pistiles were mechanically stimulated in all cases, namely by pollens got on them. Results are shown in Table 1. From the data of Table 1 it can be decided whether the supposed causes of induction produce parthenocarpic fruits in egg-plants.

Table 1

Occurrence of parthenocarpic fruits

Induction and its forms	Parthenocarpic fruits			Normal fruits	
	1963	1964	1965	1967	1963—67
Pistiles were affected by natural mechanical stimuli, i.e. *pollens*					
of the same flower	+	+	+	+	+
of the neighbouring flower	+	+	+	+	+
of another plant	+	+	+	+	+
of another variety	+	+	+	+	+
of another species	+	+	+	+	—
of another genus	+	+	+	+	—
In isolated flowers	+	+	+	+	+
In non-isolated flowers	+	+	+	+	+
In emasculated flowers	+	+	+	+	+
In non-emasculated flowers	+	+	+	+	+
In emasculated, non-isolated flowers	+	+	+	+	+
In non-emasculated, isolated flowers	+	+	+	+	+
In non-emasculated, non-isolated flowers	+	+	+	+	+
Pistiles were affected by artificial stimuli (touch)					
Emasculated and isolated flowers	+	+	+	+	—
Pistiles were not affected by stimuli at all					
Emasculated and isolated flowers	—	—	—	—	—

1. *Pollens got on the pistile.* Pollens got on the pistile induce parthenocarpic fruits of different degree in all cases independently of the degree of the pollen donor's relationship.

2. *Lack of fertilization.* Parthenocarpic fruits are produced both with fertilization and without.

3. *Isolation.* Parthenocarpic fruits develop both from isolated flowers and non-isolated ones.

4. *Emasculation.* Parthenocarpic fruit formation has been observed both in emasculated flowers and non-emasculated ones.

5. *Different years.* Parthenocarpic fruits were found on plants of different years.

In the second and third parts of our examinations the flowers were neither selfed nor cross pollinated (emasculated and isolated flowers) and the possibility of accidental mechanical stimuli was completely excluded at the present level of emasculation and isolation technics. Namely, emasculation was carried out with great care lest the pistiles should be touched with the pincers, or affected by some stimulus while isolated.

In the second part of our examinations the pistiles of flowers emasculated and isolated previously by the above method were touched with a needle, viz. the pistiles received an artificial touching stimulus. As we can see from the second part of Table 1, in this case parthenocarpic fruits have been obtained every year, and normal fruits containing seeds have not of course been found.

In the third part of our examinations, the flowers were neither selfed nor cross-pollinated (emasculated and isolated flowers), pistiles were not affected by accidental stimuli while flowers were emasculated and isolated, nor by artificial ones, as we did not touch them with the needle either. In this case, as we can see from the third part of Table 1 the organization of neither parthenocarpic nor normal fruits has started.

Conclusions

Our investigations suggest that the phenomenon of parthenocarpy in egg-plants is a hereditary predisposition rather than a determined characteristic. Hereditary predisposition is realized by mechanical stimuli affecting the pistile. The degree of parthenocarpy is determined by the extent of the predisposition and the quality of the stimulus in question (PÁL—OSVALD 1965), i.e. by the number of parthenocarpic fruits produced in the various varieties depending on the quality of stimuli.

In many cases organization of both parthenocarpic and normal fruits (containing seeds) is induced by pollens got on the pistile (pollens of the same flower, of neighbouring flowers, those of another plant or another variety; selfing, inter-pollination, cross-pollination). It is to be determined by further investigations, why under the same influence sometimes parthenocarpic fruits while another time normal ones (with seeds) develop.

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EXAMINATION OF TOBACCO NECROSIS VIRUS ON TEST PLANTS, ISOLATED FROM THE TULIP

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The properties of ten tobacco necrosis viruses, TNV (*Marmor lethale* Holmes) isolates originating from tulip, have been examined as to establish their relation with the strains hitherto described in Hungary. In the course of the experiments, it was proved, that both the normal TNV and the vein necrosis variant infected the tulip in the same way. Such plant species and sort of plants were infected successfully, that were not listed so far in the TNV host range. From among the used test plants, *Phaseolus vulgaris* L. *Fürj* was the most suitable for strain isolation.

Introduction

The appearance of tobacco necrosis virus, TNV (*Marmor lethale* Holmes) indicates an extreme danger in tulip cultivation. A physiological lesion called Augusta disease (van Slogteren 1938) was identified with the TNV in 1949 (van der Want 1948, De Bruyn Ouboter—van Slogteren 1949).

The TNV is a very wide-spread viral disease in the field of Holland, infecting not only the tulip cultivated in a big area, but bean and other culture plants, too. Presumably the TNV came to Hungary with the tulip import, as there had been no quarantine order to prohibit its importation. The TNV has already been known in Hungary since 1950 (Szirmai 1952). The infectiveness of the tulip bulbs was first reported by Szirmai (1955). The occurrence of TNV in different strains and the extraordinary variability of the pathogen demand a comparative investigation between the TNV occurring on tulips and the strains isolated earlier in Hungary. Investigations carried out with the isolates collected from the tulip are published in this paper.

Material and Method

Virus isolates for the comparative investigations have been obtained from tulip plants infected naturally. The great majority of the isolates were collected at the Model Farm of the College of Horticulture and Viticulture in Soroksár, but isolations were made in other territories, too (Table 1). After the homogenization of the virus infected leaves of tulip plants, mechanical transmissions were made onto the *Nicotiana glutinosa* L. and *Tetragonia expansa* Murr. plants. Carborundum powder was used as abrasive (400 mesh.). The isolates were maintained on *Nicotiana glutinosa* L., *Nicotiana tabacum* L., *Samsun* and *Phaseolus vulgaris* L. *Fürj* plants, with 2 weeks passage. Because of the inhibition materials of the *Tetragonia expansa* sap (Hollings 1966) the passages from this plant were unsuccessful. Isolates main-

Table 1

Origin of the tobacco necrosis virus isolates

Marking of isolates	Isolation		Tulip host plant
	place	time	
T1—T5	Soroksár	19. 4. 1967	*Scarlet Cardinal*
T6	Soroksár	19. 4. 1967	*Olaf*
T7	Soroksár	19. 4. 1967	*Golden Duchess*
T9	Keszthely	3. 5. 1967	*Fantasy*
T20	Budapest	3. 5. 1967	unknown
T21	Soroksár	5. 5. 1967	*Triumphator*

tained in tobacco — *Nicotiana tabacum* L. *Samsun* — as strain material and inocula were used from this for the infection of test plants, as well as for the determination of the physical properties. Among the physical properties, determination of the heat inactivation point was carried out in Höppler's ultrathermostat at 70, 75, 80, 85, 90 and 95° C. Determination of dilution end-point was observed between these values 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} the longevity in vitro at 18° C permanent temperature by five daily infections. In all these cases the 8—8 *Tetragonia expansa* Murr. test plant was used per value. The isolates were compared to virus strains isolated and described by SZIRMAI 1961. The optimal infection temperature was established in 19.8, 23.4, 30.8° C thermostat, on *Phaseolus vulgaris* L. and *Tetragonia expansa* Murr. plants growing on artificial illumination for 15 hours per day. Inoculations were made with T5, medium pathogenic isolates.

Results and Discussion

1. *The characterization of the diseased plant.* There were, in contrast to the type species, 0.1—1 cm size necroses (Fig. 1) on the tulip's leaves infected with TNV. These necroses appeared mainly on the under leaves but spread to the stem and in more than one case to the flower, too. Under the onion skin tissue necroses little punctiform or circular sunken and brown were found.

2. *The symptoms of test plants.* It was only SZIRMAI (1952, 1955, 1961, 1964) who dealt with the properties and symptomatology of TNV in Hungary. During his investigations he isolated TNV mainly from tobacco, bedding plants and vegetables.

In the course of his investigations on TNV isolates, he described two basic types with DNV and DNV$_b$ marks (SZIRMAI 1961).* The DNV strains represent the basic type, which is characterized by the local lesion formations brought about on the main test plant viz. on the *Phaseolus vulgaris* L. *Fürj.* The second one, the DNV$_b$ variant can in this test be characterized by the necrosis spread to the vein. SZIRMAI (1964) described a new strain of the virus, not existing in nature but being developed during the passage onto the host (TNV type).

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* The DNV and DNV$_b$ strains are marked in his other work (SZIRMAI 1964) with TNV and TNV$_b$ symbols. DNV = TNV$_f$ and DNV$_b$ = TNV$_a$.

Test plant investigations aimed at comparing them with the home results hitherto received and discovering to what extent the TNV isolated from the tulip as host plant could be identified with the virus strains described so far. Similarly it seemed necessary to complete the host range with such species that had not yet been tested by experiments as well as to see whether besides the *Phaseolus vulgaris* L., other strains are also suitable for reliable isolation of the strains. Table 2 contains the results of test plant experiments.

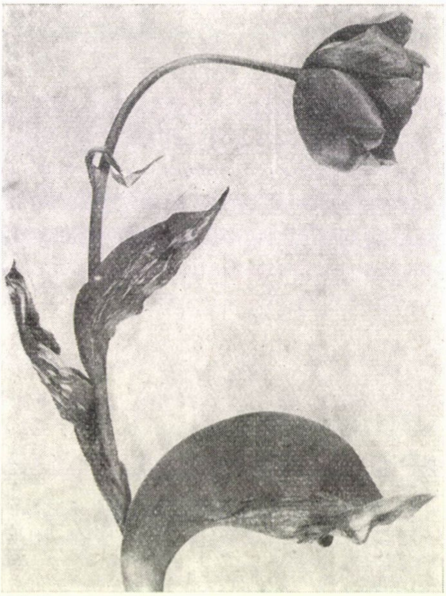

Fig. 1. Tulip infected by tobacco necrosis virus

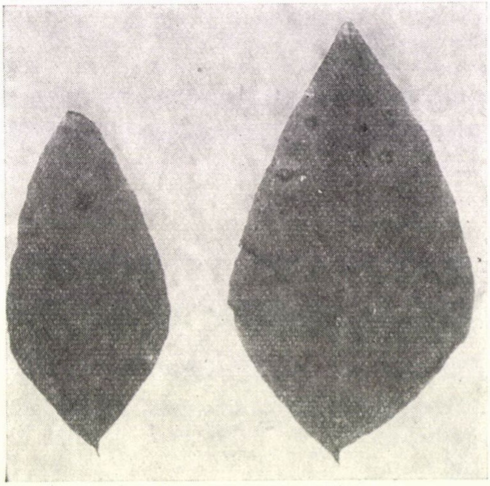

Fig. 2. Ring necrosis on infected *Amaranthus caudatus*

The symptoms appearing on the TNV hosts have proved the necrosis viral infection of tulips. Among investigated isolates basic differencies could not be established through the symptoms of test plants, different results could only be referred to in some gases. From differentiating point of view, mainly the symptoms received on the *Fürj* bean are remarkable. Some isolates (T_1, T_2, T_3) have showed identical properties with the TNV normal strain, while others (T_6) have, in the course of the test, caused vein necrosis characteristics in the TNV_b variant. Most frequently both the spot and vein necrosis types occur (T_4, T_5, T_9, T_{20}, T_{21}). In such case the simultaneous infection of the two strains has to be taken into consideration. Among the investigated species there was no plant that could differentiate like the bean. The appearance of the symptoms was influenced by the changing glasshouse environment, significantly in the case of the culture variants of *Nicotiana tabacum* L.; Not even

Table 2

Comparison of tobacco necrosis virus isolates on test plants

Test plants	Symptoms[1]	Incubation time in days	Reinfection success
Amaranthus caudatus L. (Fig. 2)	RBrNRiSp	3—10	+
Capsicum annuum L.	BlNSp[2]	5	—
Chenopodium amaranticolor Coste et Rein.	BrGrNRiSp, CoClRi, LeAb	2	+
Chenopodium quinoa Willd.	GrNRiSp, LeAb	2— 3	+
Cucumis sativus L.	BrGrNRiSp, CoClRi	3— 5	+
Datura innoxia Mill.	BlNSp[3]	5	—
Datura stramonium L.	YGrNRiSp	2— 5	+
Digitalis lanata Ehr.	BrNSp[4]	10	+
Gomphrena globosa L.	GrNSp, RCoRi	2— 3	+
Glycine soja Sieb. et Zucc.	BrNRiSp, Vn, LeAb	2	+
Lycopersicon esculentum Mill.	—	—	—
Nicandra physaloides Gaertn.	—	—	—
Nicotiana acuminata Hoods.	GrNRiSp, YCoRi	6— 7	+
Nicotiana debneyi Domin.	BlNRiSp, CoRi	5— 7	+
Nicotiana glutinosa L.	BlNRiSp, YCoRiSp	2— 3	+
Nicotiana langsdorffii Weinm.	GrNSp, GrNRiSp, YRi	4— 5	+
Nicotiana tabacum L. cv. *Hsz 129*	GrNRiSp, YCoRiSp	7—10	+
Nicotiana tabacum L. cv. *Samsun.*	GrNRiSp, YCoRiSp	7—10	+
Nicotiana tabacum L. cv. *974*	GrNRiSp, YCoRiSp	7—10	+
Nicotiana tabacum L. cv. *White Burley*	GrNRiSp, YCoRiSp	7—10	+
Ocimum basilicum L. (Fig. 3)	BlNSp, Vn, LeAb	3— 4	+
Petunia hybrida Vilm.	BlNSp	4— 5	+
Phaseolus vulgaris L. cv. *Fürj* (Fig. 4)	BrNRiSp,[5] Y, LeAb	2— 3[5]	+
	BrNRiSp,[6] Vn, StN, Tf	2— 6[6]	+
Physalis alkekengi L.	BlSp[7]	14	—
Solanum dulcamara L.	BrNSp, Cl, RiSp, LeAb	3	+
Solanum nigrum L. var. *chlorocarpum* Boiss.	BrGrNSp, LeAb	2	+
Solanum ochroleucum Bast.	GrNSp	2	+
Solanum otites Dun.	BrNRiSp, LeAb	3	+
Solanum paranense Dusek	BrBlNRiSp, LeAb	3— 4	+
Solanum sisymbrifolium Lam.	BrNSp, ClSp	2— 3	+
Solanum villosum Lam.	BrBlNRiSp, ClRiSp, LeAb	4— 5	+
Tetragonia expansa Murr.	GrNSp, BlN, Ri,[8] GrNSp, GrRi[9]	1— 2	±
Vinca rosea L.	BlNSp	7	+

Explanations

[1] Bl = black; Br = brown; Cl = chlorotic; Co = concentric; Gr = grey; LeAb = lea abscission; N = necrotic; R = red; Ri = ringlike; Sp = spot; StN = stem necrosis; Tf = tumour formation; Vn = vein necrosis; Y = yellow.

[2] Only the T5 isolate, other isolates did not cause symptoms.

[3] Only the T4, T5, T20 and TNV_b isolates, the others were symptomless.

[4] Only the T9 isolate caused symptoms.

[5] T1, T2, T3, and TNV isolates.

[6] T4, T5, T6, T7, T9, T20 and T21 isolates.

[7] Only in the case of T6 isolates, the other isolates did not cause symptoms.

[8] T1, T2, T3, T7, T9, T20, T21, TNV and TNV_b isolates.

[9] Only the T4 and T5 isolates.

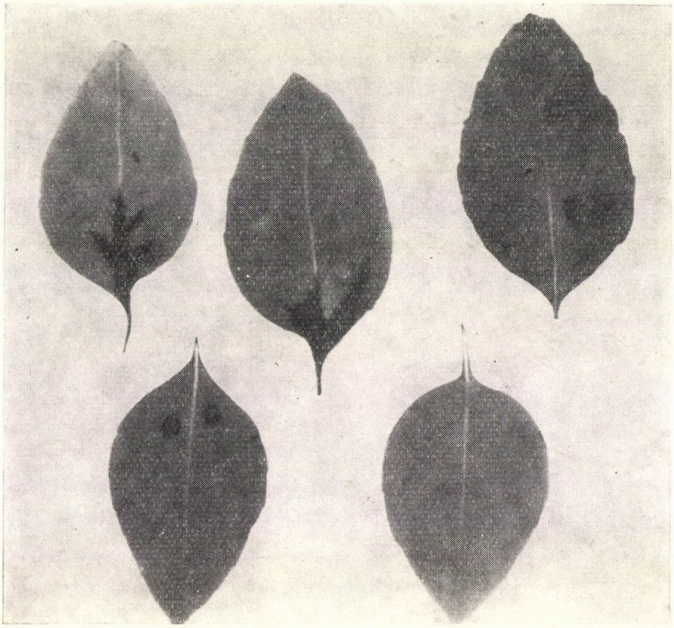

Fig. 3. Local lesions and necrosis spreading to the vein on the leaf of *Ocimum basilicum*

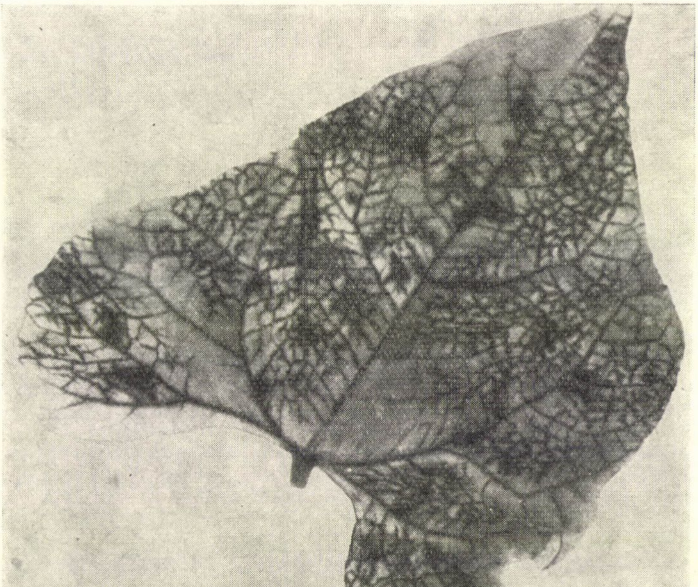

Fig. 4. Netted vein necrosis arising from local lesions, TNV_b type, on *Phaseolus vulgaris* cv. *Fürj*

Table 3

Physical properties of the tobacco necrosis virus isolates

Marking of the isolates	Heat inactivation point in °C	Dilution end-point	Longevity in vitro in days
T1	85—90	10^{-3}	15—20
T2	90—95	10^{-5}—10^{-6}	20—25
T3	85—90	10^{-6}	25—30
T4	85—90	10^{-5}—10^{-6}	20—25
T5	90—95	10^{-6}	20—25
T6	85—90	10^{-6}	25—30
T7	90—95	10^{-5}—10^{-6}	20—25
T9	90—95	10^{-6}	20—25
T20	90—95	10^{-5}—10^{-6}	20—25
T21	90—95	10^{-6}	25—30
TNV_f^1	90	50—80 000	>25
TNV_a^1	90—95	10^{-5}	25—30

[1] The results of the physical properties of the TNV and TNV_b isolates are cited from SZIRMAI's (1964) paper (TNV_f = TNV, TNV_a = TNV_b).

the *Nicotiana langsdorfii* Weinm., used as a distinctive test plant (SZIRMAI 1964) gave a satisfactory result. In spite of this there have been distinctive opportunities e.g. in the case of infections of the *Capsicum annum* L., *Digitalis lanata* Ehr., *Physalis alkekengi* L. But these results cannot be considered — in the light of the insignificant number of positive infections — as absolute ones. The symptom differences received on the *Gomphrena globosa* L. have to be evaluated similarly where deviations among the isolates were found in the diameter of the lesions.

At the infection of the *Tetragonia expansa* Murr. leaf-blade did not wither and the necrosis remained grayish-white in the case of two isolates. But these results cannot offer a firm basis either to the separation of the TNV isolates from each other or from the comparative strains.

3. *The physical properties of the TNV isolates.* Among the physical properties of the TNV isolates, only the heat inactivation, dilution end-point and the longevity in vitro have been examined. Results are summarized in Table 3. According to our experiments the TNV isolates are strongly tolerant to heat. The time to lose their virulency is as long as 10 minutes at 85—95° C. In spite of the fact that the TNV is inactivated only at such a high temperature, it is — however — very sensitive to durable temperature increase. As regards the investigation of the optimal temperature environments of the infection, data are already available. According to SZIRMAI's (1961) home results the most

Table 4

*Effect of temperature on the development of the lesions caused by TNV**

Host plant	Temperature in °C		
	19.8 ± 0.4	23.4 ± 0.1	30.8 ± 0.2
Tetragonia expansa Murr. .	37.1	60.4	13.3
Phaseolus vulgaris L. cv. *Fürj*	1.9	4.8	0.9

* The mean lesion number/cm^2.

suitable temperature is ab. 22° C. Data of similar experiments are shown in Table 4. On the bean plant grown at standard temperature — while in a chamber of higher temperature — one can observe, besides the decrease of the lesion number, the increase of the diameter of lesions. On the plants kept at 19.8 and 23.4° C the vein necrosis and thus the systematization of the disease started from primary lesions earlier.

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THE EFFECT OF DIETARY FAT ON ENERGY AND PROTEIN UTILIZATION OF RABBITS

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The concepts of added fat to the ration of growing rabbits on digestion and utilization have been extensively studied. The data obtained from this investigation show that the ration of growing rabbits has improved the digestion coefficient of the nutrients except in case of ether extract and crude fibre. The higher addition of the fat, the more improvement has occurred in digestion coefficient of the nutrients. The addition of fat to the ration has reduced respiratory quotient of the rabbits. There is a relationship between energy intake and retention of energy in the body. Percentual energy loss in respiration and as heat decreased when the energy intake increased. On the contrary, the percentual loss of energy in the faeces has slightly increased with higher intake of energy. Although the protein stored is not effected by addition of the fat to the ration, yet the stored fat has increased.

Introduction

Previous studies on the effect of nutritional planning and food utilization were made in cattle (Forbes—Braman—Kriss 1928, 1930, Forbes—Kriss 1932, Mitchell—Hamilton 1932), rats (Forbes—Kriss—Miller 1934), sheep (Marston 1948) and rabbits (Wiegner—Ghoneim 1930 and Hellberg 1949). The results of these studies show that below energy equilibrium heat production is not linearly related to food intake. Above energy equilibrium any curvilinear trend is relatively much smaller. Marston (1948) reported that this relationship is completely linear above maintenance. Mollgaard (1929), Mitchell—Hamilton—Haines (1941) and Crasemann (1947) assumed linearity of the relation between food intake and energy retention at all feeding level.

In planning experimental rations it seemed necessary to add fat to a basal ration and to feed the same amount of basal ration in all the experiments but with different amounts of added fat.

Since fats have a high energy content, their use makes possible diets extremely rich in energy and protein. Very important functions of fats are to serve as a source of energy. For this purpose they are much more efficient than either proteins or carbohydrates.

Forbes *et al.* (1946a, b, c, d) published results obtained about the rapid growth of relatively mature rats using rations varying in fat content from

2—30 per cent. Economy of energy utilization increased in accord with increase in fat content. Lard was used as fat. Similarly, **Swift** *et al.* (1947) found that an increase in digestibility of all constituents of a mixed ration occured in sheep when the mixed ration was supplemented with corn oil.

In contrast, it is probable that high levels of fats in the ration of rabbits may be expected to cause digestive disturbances and perhaps metabolic disorders.

Therefore, we deem it advisable to study the effect of dietary fat on digestion and utilization of the energy and the retention of protein and fat with growing rabbits.

Material and Methods

For the present investigation three experiments (two growing rabbits in each) were carried out at the Research Institute for Animal Husbandry, Budapest, Hungary.

In the planning of experimental rations, it seemed necessary to feed the basal ration (40 per cent maize, 20 per cent barley, 20 per cent soy-bean meal and 20 per cent lucerne dried) to the rabbits in Experiment I. In Experiments II and III, 3 and 6 per cent fat were added to the basal ration. The chemical composition of the basal ration given to rabbits was as follow:

	per cent in dry matter
Crude protein	16.56
Ether extract	2.68
Crude fibre	8.58
Nitrogen-free extract (N.F.E.)	67.91
Ash	4.27

The caloric value of one gramm from the basal ration was found to be 4319.00 gcal and for one gramm of the added fat was 9870.00 gcal.

Food was weighed in sacks at the beginning of the experimental periods. Water was available at all times.

Each experiment lasted 14 days. During the first 7 days (preliminary period) each rabbit was kept in a metabolic cage quite similar to that of **Maynard** (1951). The final 7 days (collection period) the rabbit was moved in a respiration apparatus quite similar to that referred by **Blaxter** *et al.* (1955). Necessary modifications were done to make it suitable for rabbit.

Faeces was taken daily, dried at 105° C for 24 hrs. in order to obtain the composite sample of the faeces for each rabbit during the collection period. The daily urine sample from each rabbit was made up of the same volume and three aliquots were taken, one aliquot preserved with H_2SO_4 was used in making a composite sample for the period and in which nitrogen was determined. The second aliquot was preserved by sodium fluorid for the determination of the carbon. The third aliquot was daily dried in a flat bottom Pyrex dish and at the end of the collection period the nitrogen and energy content were determined.

Nitrogen was determined by macro-Kjeldahl method (A.O.A.C. 1950). Carbon was determined by direct combustion in a stream of oxygen in a furnace packed with copper oxide and lead chromate, using the precautions listed by **Pregl** (1924). The carbon dioxide was absorbed in a solid sodium hydroxide treated with pumice stune.

Caloric values were determined in a standard pattern of bomb calorimeter. The water equivalent of the bomb was determined by use of benzoic acid. The increase in temperature of the calorimeter was measured by a thermistor circuit calibrated to give a range from 15 to 22 and to read to the nearest 0.001. Details of this instrument and instructions for its calibration and use were given by **Beakley** (1951).

Determinations were made in each of the experiments of the losses of energy, nitrogen and carbon in faeces and urine, the production of carbon dioxide, oxygen consumption and water vapour loss.

From the results the storage of energy by the rabbit as well as the respiratory quotient (R.Q.) were calculated.

The values employed for this purpose were usually those given by **Armsby** (1917).

Nitrogen retention	×6.25	= protein retention
Protein retention	×0.5254	= carbon retention in protein
Non. protein Carbon retention	×1.31	= fat stored
Fat stored (gm)	×9.5	= calories stored as fat

The digestion coefficient of the dry matter, protein and nitrogen free extract (N.F.E.) increased when fat was added to the ration. The higher added fat (to a certain level), the more improvement has happened in digestion coefficient of the nutrient. Higher improvement has occurred in case of protein. In contrast, the digestion coefficient of the ether extract as well as the crude fibre decreased when the fat level of the ration increased. Generally the digestion coefficient of the ration has improved.

Maynard—McCay (1929—1932) found that a low fat daily ration produced a marked decrease in milk volume. **Forbes** *et al.* (1946a, b, c, d) reported that economy of energy utilization increased in accord with the increase in fat content in the ration of rats. **Swift** *et al.* (1947) found that an increase in digestibility of all constituents of a mixed ration occurred in sheep. The mixed ration was supplemented with corn oil bringing the total ether extract up to 6.4 per cent.

Since the numerical value of the respiratory quotient (the relation between the oxygen consumed and carbon dioxide given off in respiration) is dependent upon the chemical nature of the substance being oxidized within the body, the addition of the fat to the basal ration reduces noticeably the R.Q. According to **Maynard—Loosli** (1951):

Protein stored (gm)×5.7 = calories stored as protein (cal.)
32 gm O_2 = 22.411 liter 760 mm pressure of mercury, 0° C
44.011 gm CO_2 = 22.41 liter 760 mm pressure of mercury, 0° C
$O_2 = (H_2O + CO_2)$ — body weight gain of the animal
R.Q. = CO_2/O_2

Results

The digestion coefficient of the nutrients is given in Table 1. It is clear that the addition of fat at certain levels improved the digestion coefficient

Table 1

Average digestion coefficient of the rations during the three experiments

	Dry matter %	Protein %	Ether extract %	Crude fibre %	N.F.E. %
Experiment I.	72.84	76.36	73.07	36.82	82.23
Experiment II	75.09	81.70	66.43	27.71	83.90
Experiment III	77.92	87.88	63.45	17.19	85.68

Table 2

Calculation of the crude values for CO_2 production and O_2 consumption

	Expt. I.	Expt. II.	Expt. III.
CO_2 production, gm ..	243.7	328.2	291.0
O_2 consumption, gm ..	160.7	259.5	230.0
R. Q.	0.967	0.953	0.919

Table 3

Mean energy, carbon and nitrogen balances during

	Expt. I.		
	Energy	C	N
Intake	2724.785	246.02	14.99
Excretion			
urine	39.767	4.89	4.07
faeces	435.061	43.20	2.07
Loss in respiration and as heat	1609.507	142.66	—
Body storage	640.450	55.27	8.85

of the nutrients (except other extract and crude fibre) in the basal ration. The higher improvement has occurred in case of the protein. It is evident also from these results that the higher fat was added (to a certain extent), the more intense improvement has happened in digestion coefficient of the nutrients of the basal ration in the rabbits.

Table 2 shows the average amount of carbon dioxide produced and oxygen consumed by the rabbits during the collection periods of the three experiments, i.e. the respiratory quotient (R. Q.) which calculated as follows:

$$\frac{\text{volume of } CO_2 \text{ produced}}{\text{volume of } O_2 \text{ consumed}} = \text{R.Q.}$$

It is obvious that the addition of the fat has reduced the respiratory quotient.

Absolute precision in each experiment was undertaken by comparing the results of energy balances determined by indirect calorimetry with those from simultaneous carbon and nitrogen balances.

The results of the energy, carbon and nitrogen balances of the three experiments are summarized in Table 3. They indicate that the addition of the fat to the basal ration raised the energy stored in the body of the animals, while the amount of the energy lost in the urine did not change in response to the level of fat in the ration, yet the loss of energy in faeces slightly increased.

Data of protein and fat stored are found in Table 4. The protein stored is slightly affected by the addition of the fat, but the fat stored as well as the total energy stored have noticeably increased.

he collection period of the three experiments

Expt. II.			Expt. III.		
Energy	C	N	Energy	C	N
2829.289	253.91	14.60	2934.155	262.22	14.25
39.792	4.42	3.37	39.816	4.07	2.68
465.237	46.30	2.36	496.412	49.60	2.63
1591.867	140.60	—	1574.771	138.64	—
732.393	62.59	8.87	823.156	69.91	8.94

Table 4

Protein and fat stored as calculated from C and N balances

Experiment	I.		II.		III.	
	gm	cal	gm	cal	gm	cal
Protein stored ...	55.31	315.265	55.44	316.008	55.88	318.516
Fat stored	34.23	325.185	43.83	416.385	53.12	494.640
Total stored	89.54	640.450	99.27	732.393	109.00	813.156

Discussion

It follows from the foregoing that dietary fat is of special nutritive significance on account of its associative effect on the digestion and utilization of energy in the ration. This fact has been proved in the present investigation. The digestion coefficient of the nutrients (except ether extract and crude fibre) has improved in the basal ration oxygen to fix the hydrogen present, and thus a part of the oxygen used in burning fats appears as water. More oxygen is consumed than is represented by carbon dioxide given off and the R.Q. less than 1.0. The results obtained from these experiments are in accordance with the fact reported previously.

From the results of the present investigation good evidence can be obtained that the percentage of total energy stored increases with the total energy intake. In other words the addition of fat to the ration consumed increases the total storage energy. Such results indicate that there is a relationship between the energy intake and the energy retention. These storage energies were 23.54, 25.78 and 28.05 percentages from the total energy intake in Experiments I, II and III, respectively. There was an agreement between these results and those of **Mollgaard** (1929), **Forbes—Fries—Braman—Kriss** (1926), **Mitchell—Hamilton—Haines** (1941) and **Crasemann** (1947). They assumed linearity at all feeding levels.

On the other hand, the percentual energy loss in respiration and as heat was decreasing when the energy intake was increasing. These values were 59.07, 56.27 and 53.67 in Experiments I, II and III, respectively.

The percentual loss of energy in faeces has slightly increased with the higher intake of energy. These losses were 15.99, 16.44 and 16.92 per cent in Experiments I, II and III, respectively.

It is evident also from the present experiments that the protein stored was nearly stable and was not affected with the level of the fat in the ration. The fat stored has increased just as the fat level of the ration has. The fat stored was 38.28, 44.15 and 48.73 per cent from the total stored (body weight gain) in Experiments I, II and III, respectively.

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A NEW, SPORADICALLY APPEARING DISEASE OF THE SUGARBEET, BETA VULGARIS VAR. SACCHARIFERA (L.) ALEFELD, AS INFLUENCED BY MICROELEMENTS OF THE SOIL, AND ITS PRELIMINARY EXAMINATION WITH DOSIMETRIC AND RADIOGRAPHIC METHODS

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The present paper deals with the recently detected physiological disease of *Beta vulgaris* var. *saccharifera* (L.) Alefeld, using radiological methods in the investigation. This disease occurs sporadically in Czechoslovakia, near Kutná Hora, on sites along the water channel for sewage disposal from medieval mines.

The disease diminishes the quantitative yield of the sugarbeet-root by 49.02 and its sugar content by 37.70 per cent; it is characterized by habit symptoms and hypoplasmatic morphoses. The symptoms of the disease are indicated by dislocations, necroses, morphoses, protoplasmatic disorganizations and bare necrotic lesions. Under the given conditions of the site the disease is induced by the radioactive elements K, Ca, Sn, Fe, Zn, Sr, Cd, Cr, which, together with the other elements: Mg, Mn, As, Na, Ti, Ag, Cu, Pb, B, are to be found in the sorption complex of soil. The healthy plants take up relatively more K than the diseased ones from the soil and distribute the natural radioactive elements equally in the beetroot. On the other hand, the diseased plants receive relatively less K from the soil and distribute the natural radioactive elements K, Ca, Sn, Fe, Zn, Sr, Cd, Cr in centres of diffuse, insular or mosaic-like type. The pathological course in the last phases of the disease leads to a mechanical obstruction of vascular elements (tracheids) in the beetroot. By the accumulation of metaplasmatic decomposition substances in the root cells plasmochisis and granulosis are caused. In diseased plants the specific activity of the dry matter of the beetroot amounts to 5.4×10^{-11} c, that of the leaves to $2.6 \cdot 10^{-11}$ c per gram, in healthy plants the corresponding values are $2.5 \cdot 10^{-11}$ c and $2.3 \cdot 10^{-11}$ c.

The topographic distribution of natural radioactive elements in diseased plants differs from that in healthy ones.

Introduction

In the sugarbeet stands of Czechoslovakia new disease forms manifest themselves, the pathogene of which is not unequivocally identified so far (Bubák 1903, Drachovská—Kočmid—Musílková 1954). The symptoms of diseases in *Beta vulgaris* var. *saccharifera* (L.) Alefeld due to the lack or excess of biogenic factors or trace elements have been described by many authors Drachovská—Černy 1957, Haan 1934, Hiltner 1933, Magnitsky 1954, Maier 1942, Russel 1936, Sannikova 1950, Schropp 1940, Skook 1941, Smolák 1955, Walker 1964, etc.). A review on the diseases caused by the excess of biogenic and trace elements concentrated from industrial aerosols in the soil is given in a bibliography and in partial works (Pešek 1965, etc). Except two papers published in Czechoslovakia (Pešek 1964a, 1964b) so far, little attention has been paid to the effect of the excess or deficiency of natural radioactive elements in the soil on the nutrition and other functions of cultivated plants (Pešek 1964a, 1964b, 1964c, 1964d, 1963).

The present state of the problem. In soil there are natural radioactive elements to be found (Bělousova—Štukkenberg 1957, Bresler 1957, Drobkov 1958, Gulyakin—Jedintseva 1962, Myslivec 1958, Pešek 1964a, 1964b, 1964c, 1964d, 1963); they penetrate through the physiological activity into the body of the plants and become localized in their different organs (Pešek 1964b). Some of the biogenic and trace elements are natural radioactive elements consisting partly of radioisotopes as follows: $^{40}_{19}K$, $^{48}_{20}Ca$, $^{50}_{23}V$, $^{87}_{37}Rb$, $^{96}_{40}Zr$, $^{124}_{50}Sn$, $^{138}_{57}La$, $^{202}_{82}Pb$, $^{209}_{83}Bi$; $^{58}_{26}Fe$, $^{92}_{42}Mo$, $^{100}_{42}Mo$, $^{138}_{56}Ba$, etc. (Bělousova—Štukkenberg 1957, Bresler 1957, Dzhelenov—Peker 1957, Siborg—Perlman—Khollender 1958). Since 1950 data have been published in the recent literature on the radioactivity of further natural elements (Strominger—Hollander—Seaborg 1958).

According to many authors the average content of alpha-active substances in plants fluctuates between $1.4 \cdot 10^{-10}$ and $3.1 \cdot 10^{-9}$ curie/kg (Evans—Evans 1948). Each plant contains per gram 1 to 20 mg of natural K, which produces 3 to 40 impulses of beta-isotope $^{40}_{19}K$ per minute. The quantity of radium in plants is about one hundredth of their potassium content and amounts only to 10^{-14} g (Vernadsky 1929). In sugarbeet K accumulates chiefly in the older leaves (Myslivec 1958). Plant ash contains per gram usually $4 \cdot 10^{-10}$ to $5 \cdot 10^{-9}$ U (Voynar 1953). Sugarbeet does not develop flowers if in its soil no uranium, radium and thorium are present (Bělousova—Štukkenberg 1957); by adding radioactive substances to the soil during the time of flowering an increase in the glycine content of sugarbeet was observed (Drobkov 1958).

Many research workers (Bělousova—Štukkenberg 1957, Hursh 1954, 1957, Muth—Schraub—Aurand—Hontke 1957 etc.) analyzed the content of radioactive elements in cultivated plants, others the effect on photosynthesis (Stoklasa 1926) and metabolism (Baranov—Gracheva 1928, Baranov—Gracheva 1935, Baranov—Ovchinnikov 1946), while cytological (Myslivec 1958 in lit.) and other investigations were carried out by numerous authors as well (Herčik 1955, Libby 1955, Pešek 1964c, 1964d, 1963, Pěnkava 1926, Pospišil 1959, Russel 1936, Slouka 1959, Straňák 1916, etc.). It is not known so far to which factors the death of irradiated cells should be ascribed (Spurný 1957). All observations on the radioactivity of plants (animals) are fairly uncoordinated and the effect of small doses has not been hitherto followed systematically, nor have been important vital functions of plants investigated, especially in connection with the radioactive background and the doses of ionizing radiation, which is received by the organism during its lifetime as a consequence of the concrete conditions of its existence (Bělousova — Štukkenberg 1957).

Task and purpose. With the work reported here it was aimed at to present the diagnostic description of a new and sporadically occurring disease of sugarbeet on the examined site and to investigate it with dosimetric and radiographic methods. The purpose of the work was the preliminary establishment of the causes provoking the disease.

Material and Method

Site. The area, in which the described disease appears, comprises some spots along the water channel dug for sewage disposal in the Middle Ages; this tract will be controlled for several years. The sewage running off earlier freely in depressions of the terrain, has been drained by the water channel since 1305 (see Reg. II., No. 2773 Archiv Kutná Hora). According to cadastral data the diseased area examined so far has an extent of about 350 ha.

Sampling for analyses. Both from the examined and control sites of the same area samples of plant material and soil were collected continuously, exactly in the different growth phases from sowing till harvesting. The experimental material was analyzed dosimetrically, radiographically and chemically.

Preparation and measuring of the samples. The preparation of soil samples for dosimetry consisted of drying at 105° C, weighing quantities of 1 g on technical scales and of adjusting them in aluminium measuring dishes.

The plant material was prepared as dry matter of 1 g weight, the samples thus obtained were homogenized by burning and their ash was put into aluminium dishes as well. All substances put into the aluminium dishes were fixed with Canada balsam.

The proper dosimetric examination of the samples was carried out with the device RA NZQ-615 constructed for measuring radioactive samples, which registered the impulses numerically on a paper band. Prior to each measuring series also the background was surveyed. From the impulse counts of a standard of known activity that of the measured samples was obtained by recalculation and expressed in the valid units of radioactivity according to the decisions of the Sixth International Radio-Biological Congress held at London in 1950.

For radiographic investigation of the samples from the plant material 2 to 3 mm thick excisions were prepared and moderately streched with cellophane foil in a press between two small plexiglass plates for 48 hours. Subsequently the excisions were dried, kept under moderate pressure in order to prevent the extension and the warping of the tissue. Radiographic investigation of the samples was performed to establish the topographic distribution of radioactive elements in the different anatomical elements of the plant. The present state of knowledge in this field was also surveyed (Demers 1958, Krongants 1953, Norris—Woodruff 1955, Radiografija 1952, Yagoda 1949, etc.). The radiograms were constructed according to the world-over accepted methodology described also by many authors (Demers 1946, 1958, Hevesy 1953, Chamie 1929, Lauda 1955, Libby 1955, Lissitzky—Michel 1952, Majer 1961, Myslivec 1958, Picciotto 1949, Weil—Williams 1951, Zemědělská 1962), but the findings of older authors (Bequerel 1896, Reiganum 1911, Crookes 1900) were taken into consideration as well.

In conformity with the accepted and above-mentioned methods of constructing radiograms the prepared samples were put in darkness on a sensitive photo-layer; between the latter and the sample a cellophane foil was put. Subsequently the photomaterial and the sample were wrapped in a tinfoil and charged with a lead prism to fasten the samples (excisions) closely to the photo-layer. As detection material, photographic plates "ISOPAN Agfa ISS 21°/Din" were used, making the exposure in a dry room and darkness for 20 × 24 hours. These plates answer topographic purposes, this was confirmed by previous trials of the author (Pešek 1964b, 1964c, 1964d, 1963). The negative material was developed in the usual manner, subsequently, by magnifying, positive radiograms were made and on the basis of these the proportions in the topographic distribution of the natural radioactive elements assessed.

Microscopic excisions. In order to evaluate the topographic distribution of radioactive elements in the 2 to 3 mm thick excisions taken from the samples for radiographic analysis and prior to it from the same material microscopic excisions were prepared for comparison. By portraying these microscopic excisions, i.e. the corresponding plant tissues, anatomical pictures were obtained, which were compared with the radiographically evaluated analogous excisions; subsequently on the basis of the radiogram the topographic distribution of radioactive elements in plant tissues was portrayed. The rightness of the microscopic delineation was confirmed with many classic works published on this matter (ARTSCHWAGER 1926, ELISABETH 1937, ESAN 1934, HAYWARD 1938, MATTHYSEN 1912, OVERPECK 1931, PLANT 1910, RÜGGEBERG 1912).

Analytical determination of the elements. The analytical determination of potassium (and other elements) as the most important source of natural radioactivity in plants (MYSLIVEC 1958, VERNADSKY 1929) and the comparison of the data was performed according to the method of DOLEŽAL—ZÝKA (1961) with potentiometric titration of the ash (HEYROVSKY 1958, KEMULA—KORNACKI 1954, LANGER—STEVENSON 1942, SONDBERG 1951, 1946, SUESS 1956, YASUMORI 1952); the results of other authors were also considered and compared (BĚLOUSOVA—ŠTUKKENBERG 1957, HURSH 1954, 1957, MUTH—SCHRAUB—AURAND—HONTKE 1957). The semi-quantitative analysis of plant parts measured for orientation served as control of the analysis. The quantitative results of the chemical analysis were compared with the data of dosimetric measurement [impulses (counts) per time unit, e.g. minute = cpm].

Documentation from the terrain. The results of surveying in the field were registered chronologically each year and evaluated with biometrical methods. The documentation from the terrain was photographically fixed and the probable area of the diseased sites inscribed into the cadastral map. The methods of phytopathological and agronomic investigations are described in the chapter "Discussion".

Results

I. *Specific symptoms of the disease (in the growth phase of the fifth leaf whorl, July 5, 1962).* Diagnosis: General feature of morphological (external) symptoms. Symptoms shown by the habit are: considerable stunting of the plants, curling, wilting and drying of the oldest leaves. Necrotic destructions, i.e. falling down of died tissues were not observed. The young, still undeveloped leaves and the petioles have a normal colour. Their nervature and the intermediate tissue are yellowish green. The plants reach the stage of 7 to 11 leaves and perish at this level of development.

In the course of the disease the beetroot does not shrivel, nor has it a bad smell, but maintains its peculiar aroma after cross cutting. Externally no symptom of a disease can be observed on the surface of the root.

On the radial, transversal and tangential cross section of the beetroot (radix) irregularly limited black centres are to be seen; these are groups of granules with localized natural radioactive elements organized as anatomically morbid corpuscles in the cells and tissues. The anatomical distribution of these centres in the root tissues is specific (typical) as to their form and extent, this can be proved macroscopically and radiographically. In the interior of the radix the centres can be observed macroscopically already from the beginning of the discolouration, and become sharply visible in the drying stage of the leaves. Radiographically they can be detected already at the commencement of stunting of the plants.

a) The centres of the diffuse type are irregularly, sometimes sharply circumscribed, they occur in the pith from the first to the *n*th cambium ring with deuteroxylem and externally with deuterophloem in the parenchyma and the other cambial series. They ascend to the rhizoderm and appear externally as irregular (hardly visible) spots on the beetroot. The centres in the deuteroxylem, deuterophloem and parenchyma are 1 to 10 mm, those ascending to the rhizoderm 2 to 60 mm in diameter.

b) The centres of insular type are circular, always sharply limited, very distinct, occurring exclusively in the xylem, and have a diameter of 0.1 to 10 mm.

c) The centres of mosaic-like type are sharply bordered, small and analogous with the course of the anatomical elements of the beetroot in regular rows arranged. These small centres accumulate closely to irregular spots of 1 to 60 mm diameter.

Macroscopically visible black centres in the interior of the root correspond to those of localized natural radioactive elements on the radiogram, i.e. due to the localized radioisotopes (representing the isotopic constituents of the natural radioactive elements) the black centres display radioactivity. Depending on the degree of localization the centres are brown or black. The capillary roots show normal development, exudates were not observed.

The symptoms of disease are: dislocations, necroses, morphoses, antemortal deformations, i.e. protoplasmatic desorganizations or necrotic, plesionecrotic conditions, or mortal and postmortal, i.e. bare necrotic lesions.

The traces have the character of necrotic symptoms and lead to the death of the attacked tissues. The necrotic metamorphoses have the form of local, more or less limited spots (violet spots on the leaf tip).

The disease shows the following progress:

1. The stunting of the whole plant but still retaining the normal colour of the assimilatory organs (latent disease state).
2. Discolouration of the stunting leaves (oxychromis), formation of macroscopic centres in the beetroot (plasmochisis and granulosis).
3. Curling and wilting of the leaves, extension of the centres in the radix, increased localization of the natural radioactive elements in the granules and development of morbid corpuscles.
4. The wilting (necrotic) of the leaves.
5. Death of the plant.
6. Postmortal partial mumification of somatic cells in the beetroot.

The mumification of somatic root is accompanied by abnormal blackening of the dying tissue as a consequence of pathological physiological processes.

II. *Histological symptoms (internal traces)*. The pathological structural changes in the cells and tissues of *Beta vulgaris* var. *saccharifera* (L.) Alefeld showed necrotic symptoms leading to degeneration and death of the attacked tissues as well as hyperplasmatic symptoms, inducing the ceasing of growth and the differentiation of cells and tissues.

In the given case the plesionecrotic symptoms characterized by the deposition of metaplasmatic substances came into being under the influence of accumulated natural radioactive elements and of those, which, under the prevailing conditions, had been present in the sorption complex of the soil of the examined site. They manifested themselves in the following forms (valuated according to the system of KÜSTER 1916, see LAUDA 1955).

A) Granulosis, i.e. morbid formation of granules which consist of polyhedric corpuscles in the degenerated protoplasma of the beetroot and arise in the root centres by translocation and localization (distribution) of natural radioactive elements as well as of others present in soil of the site. The mechanism, causing the death of cells and their metamorphosis into the above described form could not be explored so far (see also SPURNÝ 1957).

The succession in the formation of the centres, i.e. the localization of the natural radioactive elements in the radix occurs chronologically as follow.

1. Translocation and absorption of radioactive elements from the soil into the capillary roots and subsequently into the vessels of the beetroot.
2. Differentiated localization (vertical formation of diffuse, insular and mosaic-like centres; horizontal development of diffuse, insular and mosaic-like centres).
3. Progressive concentration of natural radioactive elements in the centres with simultaneous development of granules.
4. Translocation of natural radioactive elements from the previously formed elements of the radix into more distant ones and aggregation of the centres into larger units.

Where centres develop, the tissue cells die off and become mumified; the process causing this change is a pathological one. An accumulation of substances deriving from metaplasmatic decomposition was proved, too; in the given case these were the radioisotopes K, Ca, Sn, but beside them also other radioactive and stable elements occurring in the absorption complex of the soil of the site were found. In case of other diseases and plants the accumulation of organic reserve substances, e.g. of starch (hyperamylosis) is an analogous phenomenon; the pathological process described above could analogously be called hyperkaliosis.

B) Plasmochisis. This term denotes the formation of granules in the beetroot, i.e. the breakdown of the cytoplasm, its organs and constituents. In the root the cells die and become progressively mumified. The granules, i.e. the polyhedric corpuscles in the interior of the anatomical elements, influence the radix, they cause mechanical obstructions in the transpiratory vessels, affect pathological functions in the plant and induce disproportions in the water supply as well as disturbances in the whole metabolic system: the leaves wilt and die off. In the leaves oxychromis, i.e. the oxidation of the pigments in the cells, can be observed, this is the probable reason for the browning of leaves accompanying the death of the organs.

The histological symptoms appear in the following chronological succession: 1. plasmochisis, simultaneously in the root and leaves of the beet, 2. granulosis, in the beetroot.

III. *The uptake of potassium by diseased plants on the examined site and by healthy plants in the same region (outside the examined site).* The relation of total potassium content available in the soil to the proportion uptaken by the plants, i.e.

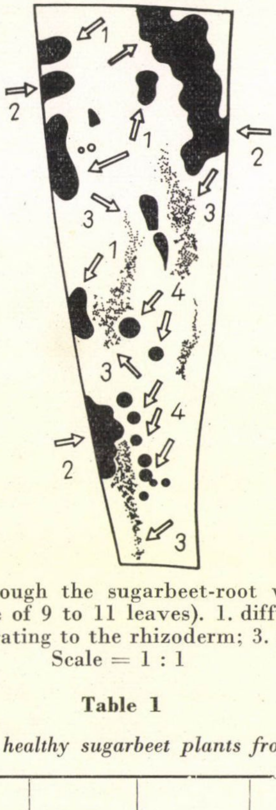

Fig. 1. Longitudinal section through the sugarbeet-root with macroscopically observable centres of died cells (in the state of 9 to 11 leaves). 1. diffuse type, not penetrating to the rhizoderm; 2. diffuse type, penetrating to the rhizoderm; 3. mosaic-like type; 4. insular type. Scale = 1 : 1

Table 1

Uptake of K by diseased and healthy sugarbeet plants from soil of the examined area

Site	A	B	C	D	E			
					BV		LT	
					mg	%	mg	%
Lo	$2.2 \cdot 10^{-10}$	25.42	55.87	40.00	6.11	24.03	3.75	14.00
Lz	$1.0 \cdot 10^{-10}$	12.10	36.32	83.33	4.27	35.58	2.61	21.00

Symbols: Lo = site of the diseased plants; Lz = control site of healthy plants (in the same region); A = specific activity of the soil in curie; B = quantity of natural potassium (mg) in 1 g soil; C = counts of impulses from 1 g soil per min, D = quantity of K (mg) in 1 g soil; E = from the total potassium content of the soil (25.42 mg) (g = 100%) the sugarbeet uptakes for the production of 1 g dry matter in the BV = root (radix) and in the LT = leaves mg (%) of K.

$$\frac{\text{total amount of K available in the soil}}{\text{quantity of K uptaken by the plants}}$$

demonstrates clearly that the uptake by the diseased plants is considerably lower (see Table 1). Healthy plants uptake relatively more K from the soil; for the production of 1 g dry matter in the beetroot they demand 35.58 per cent and for that in the leaves 21.66 per cent of their total K requirement

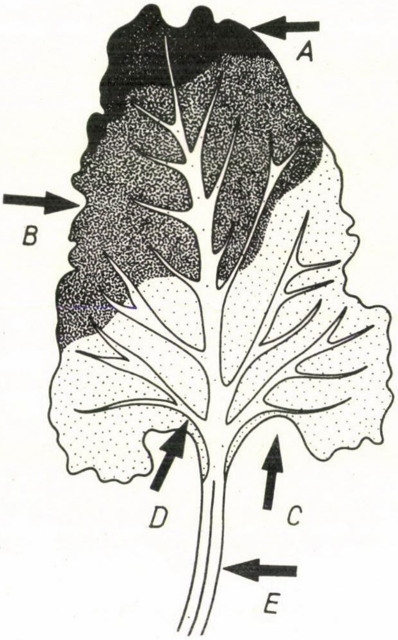

Fig. 2. Disease symptom on the sugarbeet leaf (in the state of 9 to 11 leaves). The leaf dies off from the tip, showing a contagious and equal ochre brown-violet colouration, turning later into a dark brown irregularly limited spot. The leaf does not fall. A = violet tip of the leafblade; B = dark brown part of the leafblade; C = yellowish green tissue among the leaf veins; D = light yellowish green nervature; E = petiole of normal green colour. Scale=1:1

Fig. 3. Positive radiogram of the longitudinal section through the diseased sugarbeet-root (in the state of 9 to 11 leaves) from the examined site. The localization of the natural radioactive elements (black spots visible on the radiogram in the interior of the root) is identical with the macroscopically brown or black centres. On the radiogram insular, diffuse and mosaic-like centres are visible. Analysis of the root: July 3, 1962. Exposure: 20 × 24 hours. Negative material: photographic plates: ISOPAN/Agfa ISS 21°/Din. Scale = 1 : 1

Comparison of the K contents in the assimilatory organs proved that diseased plants accumulated 14.66 per cent of their total K uptake in the leaves. This proportion induces physiological disturbances, which are mainly due to the

Table 2

Dosimetric examination of the plant material

Number of the		Dry matter of 1 g samples in	Counts of impulses in			
sample	plants		300	300	300	15
			seconds			minutes
I. G	—	Background	31	33	29	93
1	1	BV	127	113	102	342
7	1	LT	127	113	117	357
10	2	BV	115	141	139	395
2	2	LT	128	112	105	345
4	3	BV	115	139	113	367
5	3	LT	141	117	123	381

Note: The impulses were registered with the device NZQ 615 in 1 g dry matter of diseased sugarbeet plants of the examined site. — Samples taken: July 3, 1962.

Symbols: BV = root (radix); LT = leaves.

increased localization of natural radioactive elements in the centres developing in the interior part of the radix.

IV. *Topographical distribution of natural radioactive elements in the root of diseased sugarbeets.* The topographical distribution of natural radioactive elements in the root of diseased plants are shown in the Figs 1, 3. The natural radioactive elements are localized in the rhizoderm ($1 \cdot 10^{-10}$ c), calyptra ($2.2 \cdot 10^{-10}$ c), radix ($2.2 \cdot 10^{-10}$ c), epicotyl ($1.2 \cdot 10^{-10}$ c) and in

Table 3

Dosimetric examination of the plant material

Nr. of the plant complex	Plant part	A	B	C	D	E
1	BV	342	93	249	16.60	.
2	BV	395	93	302	20.13	. 18.33
3	BV	367	93	274	18.26	.
1	LT	357	93	264	17.60	.
2	LT	345	93	252	16.80	. 11.20
3	LT	381	93	288	19.20	.

Note: The impulses were registered with the device NZQ 615 in 1 g dry matter of samples from diseased plants of the examined site. — Samples taken: July 3, 1962. The complexes of diseased plants were chosen at random and contained 30 specimens each.

Symbols: BV = root (radix); LT = leaves; A = mean of impulses with background in 15 minutes; B = mean of impulses of the background in 15 minutes; C = mean of impulses without background in 15 minutes; D = mean of impulses without background in 1 minute; E = mean of impulses of the plant complexes 1—3 without background in 1 minute.

the black centres ($2.2 \cdot 10^{-10}$ c). They penetrate from the surrounding soil into the root ($2.2 \cdot 10^{-10}$ c), are acting as natural radiants in the interior of the plant and become translocated by its physiological activity. The vertical translocation takes place through the vessels and from these the horizontal translocation proceeds, mostly from left to right representing chiefly a shift toward the central part.

V. *The sorption complex of the soil in the examined site contains* 1. natural radioactive elements (K, Ca, Fe, Zn, Sr, Cd, Cr) and 2. natural non-radioactive elements with stable isotopes (Mg, Mn, As, Na, Ti, Ag, Cu, Pb, B); all these may have participated in the described disease of the sugarbeet under the given conditions of the site. Out of the above-mentioned elements the following were analytically established in the plants.

Proportions	Elements
Main proportion . . .	K
Median proportion .	Ca, Mg, Fe
Very small proportion	As, Na, Mn, Zn
Traces	Ag, Cu, Pb, Ti, Sn, Sr, Cr, Cd

Note: The list of natural radioactive elements see in lit. (Bělousova—Štukkenberg 1957, Bresler 1957, Gulyakin—Jedintseva 1962, Dzhelenov—Peker 1957, Maier 1942, Myslivec 1958, Muth—Schraub—Aurand—Hontke 1957, Penkava 1926, Siborg—Perlman—Khollender 1958, Stoklasa 1926, Zemědělska 1962, Vojnar 1953, Srominger—Hollander—Seaborg 1958).

Table 4

Comparison of natural radioactivity in diseased and healthy plants of the examined region

Plant part	A	B	C	D
OR—BV	$5.4 \cdot 10^{-11}$	18.33	6.11	163.934
OR—LT	$3.2 \cdot 10^{-11}$	11.20	3.73	270.270
ZR—BV	$2.6 \cdot 10^{-11}$	12.83	4.27	334.400
ZR—LT	$2.3 \cdot 10^{-11}$	7.84	2.61	383.100

Note: The data refer to the growth phase of the fifth leaf-whorl, which in diseased plants appears at the beginning of July (see: specific symptoms of the disease, Diagnosis, in the text).

Symbols: OR = diseased plants; ZR = healthy plants; BV = root (radix); LT = leaves; A = specific activity of 1 g dry matter in curie; B = impulses of 1 g dry substance (without background) in 1 minute; C = content of K (mg) in 1 g dry matter; D = 1 g K is contained by g dry matter.

VI. *General remarks.* The economic importance of the recently detected disease in the examined site is considerable, because it decreases the quantitative yield of the beetroot by 49.02 per cent in comparison to healthy plants of the same region.

The statistical analysis proved the probable occurrence of the disease infesting *Beta vulgaris* var. *saccharifera* (L.) Alefeld on the examined site $(P)A_n^m = 0.999$); the null hypothesis with 1 and 5 per cent probability evidenced that the disease does not occasionally appear.

Discussion

Diseased plants of *Beta vulgaris* var. *saccharifera* (L.) Alefeld were analyzed not only according to special dosimetric and radiographic procedures but also investigated with phytopathological and other methods. On the basis of experimental measurements on the possible causes the following hypotheses were set up and also experimentally controlled:

1. The disease is induced by a virus. Artificial infections performed with the inoculum from diseased plants gave negative results. The symptoms of the described disease do not correspond with those observed in known virus diseases of the sugarbeet and registered in the literature (see: Drachovská—Černý 1957, Drachovská—Kočmíd—Musílková 1954, Hiltner 1933, etc.).

2. The disease should be attributed to mycosis, aktinomycosis, bacteriosis. The diseased plants were examined for mycoses of the superficial, intermediate and interior cells as well as for actinomycoses and bacterioses of the vessels and sap tissues. The results were negative. The symptoms of the described disease were compared with those found in some injuries of the sugarbeet and established so far by literature as parasitic damages (see: Blattný 1949, Bubák 1903, Drachovská—Černý 1957, Drachovská—Kočmíd—Musílková 1954, Hiltner 1953, Smolák 1955, etc.). The symptoms registered in parasitic infestations by literature (Smolák 1955) do not correspond with those of the disease described here.

3. The disease is caused by nutrition. Suspicion was thrown on the toxicity of the basic substances deriving from the sewage of mines and found in the absorption complex of the soil so far (see: Analysis, Samples 1911—1914, Pácal—Havlíček); especially Mg, Fe, Mn, Zn, As, Na, Ti, Ag, Cu, Sn, Pb, B, Cr were suspected. Conducting vegetation experiments with potted plants, to which the above-mentioned and other biogenic elements were added in different quantities and variations, symptoms not identical with those of the described disease were established. The symptoms of the disease in question were compared with the data presented in the key for diseases caused by the lack (excess) of biogenic and trace elements (Magnitsky 1954, Schropp 1951,

etc.; see also: DRACHOVSKÁ—ČERNÝ 1957, HAAN 1934, HILTNER 1933, MAGNITSKY 1954, MAIER 1942, SANNIKOVÁ 1950, SCHROPP 1940, SKOOK 1941, SMOLÁK 1955).

The symptoms of deficiency diseases enumerated in the keys do not correspond with the examined ones.

On the basis of measurements, observations and statistical data the hypotheses dealt with under the items 1, 2 and 3 had to be rejected.

4. The disease has a physiological character and is caused by elements present in soil of the examined site. Pathological structural changes in the tissue of the beetroot, i.e. necrotic and hyperplastic symptoms, especially the accumulation of metaplasmatic decomposition substances in the beetroot, relative decrease of the K uptake from the soil indicate physiological disturbances. The substances deriving from metaplasmatic break-down and causing granulosis in the root were for the most part identified as the natural radioactive elements K, Ca, Sn (main proportion), Fe, Zn, Sr, Cd, Cr (medium proportion and traces), mixed with basic (not radioactive) substances present in the sorption complex of soil. The specific activity of the dry matter of the radix ($5.4 \cdot 10^{-11}$ c) exceeded probably that observed in the root of healthy plants ($2.6 \cdot 10^{-11}$ c) in the same region.

The experiment conducted with potted plants, to which natural radioactive elements (K, Ca, Sn, Fe, Zn, Sr, Cd, Cr) were added in different quantities and variations, yielded a positive result (i.e. the symptoms of potted plants corresponded with those of the disease observed on the examined site, and the radiological characteristics, the chemical composition, etc. were also identical in both cases), therefore this result was subsequently controlled in further vegetation tests. In these the same variations of added basic substances were applied (in several replications) but other species (*Triticum aestivum* L., *Secale cereale* L., *Zea mays* L., *Hordeum sativum* Jessen., *Pisum sativum* L., *Phaseolus vulgaris* L., *Trifolium arvense* L., *Trifolium repens* L., *Lotus corniculatus* L., *Solanum tuberosum* L., see the author's own observations — PEŠEK 1964a) were used as indicator plants. The experimental result was positive. The effect of the above-mentioned radioactive elements inducing the physiological disease of the sugarbeet was also proved by the methods previously described. The variant of using indicator plants in the experiment was applied, because beside the sugarbeet the other cultivated plants became also diseased in the examined area (PEŠEK 1964a).

The result of experimental measurements, their biometrical evaluation and control with the null hypothesis on the 1 and 5 per cent probability level proved that the described disease of the sugarbeet was provoked by the above enumerated elements present in the absorption complex of soil of the examined site.

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STUDIES ON PUNGENT SUBSTANCES IN THE FRUIT OF CAPSICUM ANNUUM L. AND IN SOME OTHER SPECIES OF THE CAPSICUM GENUS

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The capsaicin that causes the pungent taste in the fruit of *Capsicum annuum* L. has recently been separated into two components (KOSUGE *et al.* 1958). The quantitative and qualitative change of these two components in the fruit of the varieties belonging to the form of *Capsicum annuum* L. and in those of other species of the genus *Capsicum* have been studied by layer-chromatography in two stages of development. It has been established that capsaicin *a* and capsaicin *b* occur together in the fruit of all the pungent varieties and species, respectively, being examined by us; generally, capsaicin *a* is present in a larger quantity than capsaicin *b*.

Introduction

To the family *Solanaceae* there belong a considerable number of species (as e.g., *Datura stramonium*, *Hyosciamus niger*, *Atropa belladonna*, *Withania somnifera*, *Solanum laciniatum* and the other species of the *Solanum* genus) the drugs of which are important on medical science. Of the species also belonging to the family of *Solanaceae*, the *Capsicum annuum* L. being a cultivated and best-known species, excels in its richness of varieties and the varieties, especially those producing fruit with pungent flavour, have been used, long time back, in popular therapy and in circles fighting against different illnesses by way of natural treatments.

It was TRESH (1876) who first tried to isolate capsaicin, the substance causing the pungent flavour of the fruit, and it was him who gave name to the substance, however, MICKO (1898) was the man who produced it from the "*Király*"paprika in the required quantity and purity; the latter had also set up the aggregate formula that became confirmed by later investigations. The structural formula was solved by NELSON (1923) according to whom the capsaicin is a vanillylamine acylized with decylenic acid.

KOSUGE *et. al.* (1958, 1959) have separated the capsaicin into two pungent components that do not differ considerably in their physical and chemical properties. TYIHÁK *et al.* (1965, 1966) have also distinguished the two pungent components of capsaicin first by a layer-chromatographic method and then through column-chromatography (1967), however, the identification of these has not yet been done with the pungent substances isolated by KOSUGE *et al.*

(1958). At the same time TYIHÁK *et al.* (1965, 1966, 1967) have proved the presence of substances having protoalkaloid character in the fruit of paprika varieties examined by them; one of these has also been isolated, in pure state, too. FRIEDRICH *et al.* (1965), when separating, with layer-chromatography, a synthetic pungent substance and the natural capsaicin reported as well on having separated the natural capsaicin into a main- and a by-component; however, concerning their structure they mention the main-component "to be identical — according to the IR-spectrophotographic examinations — with the trans-capsaicin, while the by-component is not cis-capsaicin; one may have dealt in this case with a dihydro derivative of capsaicin".

Of the pharmacological results the effect of the purely produced capsaicin on body temperature as well as on the digestive and secretory organs is to be mentioned, and recently considerable investigations have been carried out in connection with the local desensibilizing effect of capsaicin. Among its therapeutical uses the application of capsaicin ointments (e.g. capsoderma) in cases of rheumatic illnesses is well-known and, in general, in those where local hyperaemia might help (MOLNÁR 1965).

Authors have examined, with the layer-chromatography method at two developmental stages (TYIHÁK *et al.* 1966, 1967), the substances causing pungency as well as other substances of protoalkaloid character in the large number of varieties belonging to the category of *Capsicum annuum* L.; in this paper, however, authors want to report on their studying the two pungent components of capsaicin occurring together.

Material and Method

For the examinations the fruit of different varieties of *Capsicum annuum* L., in state of entire development and biological ripeness, had been gathered at the Soroksár Experimental Station of the Branches of Instruction in Vegetable Production and Agricultures, School for Horticulture and Viticulture. For setting up material, authors have availed themselves of the method suggested by TERPÓ (1966). In the cases concerning *Capsicum conicum* (Syn. *C. frutescens*), *C. angulosum* (syn. *C. pendulum*) and the *C. pubescens* there have been used plants fruit grown from seeds originated from different botanical gardens. The plants examined are grouped as seen in Table 1.

On the methods of examining the components of capsaicin, detailed report has been submitted (TYIHÁK *et al.* 1967), in this paper authors want to give only a brief description on the method used in their present investigation.

A layer (250 μ) of the sorbent MN-cellulose powder 300 (Macherey—Nagel Co., Düren, Germany) was applied with the aid of the Desaga layer-spreading device. The sorbent layer was allowed to stand for one night, and some of the capsaicin solution was dripped on it; the same was done with the extractions of the paprika fruit that had been prepared in the following way: 1 g of the fruit ground to powder had been extracted with 3×5 ml petrol ether after which the powder freed from the solving material, was extracted with 3×5 ml methanol, and from this blended methanol solution 0.05 ml was dripped on the carrier. The mixture of 0.1 M NaOH, 0.2 M Na-acetate and 0.3 M Na_2CO_3 was used as solvent in the ratio 2 : 3 : 5. After a run of 16 cm, the plates were taken out, dried and developed with the following reagent:

a) The plate was sprayed with a mixture of 15 per cent $FeCl_3$ and 0.5 per cent $K_4[Fe(CN)_6]$ in distilled water the ratio being 1 : 1. The capsaicin components (being called temporarily capsaicin *a* and *b*), appeared in dark-blue colour.

Table 1

Taxonomy of Capsicum genus

Capsicum annuum L.	Variety (origin)	Number of exp.
I. ssp. *baccatum* (L.) Terpó	Ferrara	349
	Szeged	372
II. convar. *annuum* L.		
provar. *cerasiforme* (Mill.) Irish		
conc. *sphaericum* (Willd) Terpó		
cv. *Csokros cseresznye*		115
cv. *Apró cseresznye*		27
cv. *Cseresznye paprika*		86
	Ferrara	358
	Szeged	362
provar. *fasciculatum* (Sturt.) Irish		
	Soroksár	48
	Ferrara	360
	Budapest	108
III. convar. *longum* (DC.) Terpó		
provar. *acuminatum* Fingerh.		
cv. *Sárga Chilli*		103
provar. *brevidactylus* Fil.		
conc. *nigrum* (Willd.) My.		
	Soroksár	29
	Major	123
provar. *rectum* Fingerh.		
conc. *pannonicum* Terpó		
cv. *Hatvani*		84
cv. *Hatvani legkorábbi*		1277
subconc. *pendens* My.		
cv. *Kalocsai csípős*		6
provar. *incrassatum* Fingerh.		
conc. *szegediense* My.		
cv. *Szegedi csípős*		113
provar. *longum* (DC.) Sendtn.		
conc. *longum*	Szeged	363
conc. *luteum* Fingerh.	Ferrara	357
IV. convar. *grossum* (L.) Terpó		
provar. *pomiforme* Fingerh.		
conc. *obtusum* Terpó		
cv. *Kupos*		14
provar. *abbreviatum* Fingerh.		
conc. *erectum*		
cv. *Bogyiszlói*		82
provar. *ovatum* Fingerh.		
conc. *hungaricum* Terpó		
cv. *Cecei*		83
provar. *tetragonum* (Mill.) Terpó		
conc. *rubrum* Aug.		
cv. *Paradicsom alakú* green		2
cv. *Paradicsom alakú* green, elong. type		11
cv. *Sumeni paradicsom paprika*		43
cv. *Édes paprika*		120
provar. *crossum*		
conc. *latum* (Erw.) Terpó		
cv. *Kaliforniai*		21
conc. *cordatum* (Fingerh.) Terpó		
cv. *Kalinkói*		45
Bulgár U/21		4
U/22		68
U/23		69
Bulgár 11		117

Table 1 cont.

Capsicum frutescens (C. conicum)	Variety (origin)	Number of exp.
cv. *Tabasco*		
	Soroksár	28
	Ferrara	350
	Szeged	352
Capsicum angulosum (C. pendulum)		
	Wille USA	106
	627	127
	628	107
	629	126
	C. angulosum	111
cv. *Csokros 11*		114
Capsicum pubescens	*3463 Copenhagen*	125

b) 0.35 g sulfanyl acid in 4 per cent acetic acid (100 ml) and 0.35 g $NaNO_2$ in distilled water (100 ml) (the latter must always be fresh-prepared) were dissolved and poured together in the ratio 1 : 1. The layer had been sprayed with that solution; it was then dried at room temperature then sprayed with 0.5 n NaOH, when the pungent components appeared in brick-red colour. Capsaicin *a* (Rf = 0.34) and capsaicin *b* (Rf = 0.25) got well separated from each other under the conditions examined.

The two isolated pungent substances showed the same sensitivity to the two reagents, and thus their being used together caused no problem.

On the chromatograms (Figs 1 and 2) the capsaicin spots were drawn in full lines and the spots were cross-lined. The unknown components were drawn partly with empty unbroken lines, partly with dotted lines. The empty spots drawn with unbroken line demonstrate the substances giving a colour reaction similar to the capsaicins.

Results and Discussion

The layer-chromatograms of varieties belonging to the form of *Capsicum annuum* L. is shown in Fig. 1. In the first place of the chromatograph picture the two components of capsaicin can be seen together; they had been isolated from the fruit of the "*Szegedi csípős*" belonging to the category of the *C. annuum* convar. *longum*. It is easy to see that the capsaicin *a* is present in a quantity by one and a half times or twice bigger than that of capsaicin *b*. Besides the test material there can be seen the representative layer chromatography picture of some characteristic kinds (349, 358, 362, 29, 123) of provarieties belonging to the category of the subspecies and convarieties, respectively, of *C. annuum* L. In the varieties, capsaicin *a* and capsaicin *b* occur together, the ratio being generally 1.5—2 : 1, showing that capsaicin *a* is present in a larger quantity in the fruit of other varieties, too. The considerable differences in total capsaicin content are well known in the varieties producing fruit with pungent flavour (Spanyár *et al.* 1956), a fact that has been experienced also in the present investigations, still on the basis of our examinations we might establish that the capsaicin content of pungent varieties belonging to the *Capsicum annuum* form shows primarily quantitative differences. The non-pungent varieties belonging to the form of convar. *grossum* (1277) did not contain — of course — either of the capsaicins.

The other species of the *Capsicum*-genus: *C. conicum*, *C. angulosum*, *C. pubescens*, are of pungent flavour (OHTA 1962). From the works of OHTA (1962) we also learn that *C. angulosum* (syn. *C. pendulum*) and the *C. pubescens* are remarkable for their great capsaicin content concerning both the dry material per cent and the total capsaicin content. Examining the extracts of the fruit gathered from plants grown from seeds coming from different botanical gardens, results were obtained as seen in Fig. 2. In Fig. 2 the capsaicin (the two components together) isolated from the fruit of the variety *"Szegedi csípős"* belonging to the form *C. annuum* convar. *longum* is used as test material. The chromatographic picture shows, in order of succession, the extract of the fruit *C. frutescens* (syn. *C. conicum*). The re-products of seeds coming from two places (Ferrara, Soroksár) show different performance. In the Soroksár sample no capsaicin could be proved, however, the sample coming from the other place (350) shows identity with the varieties of *C. annuum* regarding its pungent substances. In the fruit-extract (106, 107, 111, 114, 126, 127) of *C. angulosum* (syn. *C. pendulum*), too, the presence of the two capsaicins can be well detected, however, in one of the samples with higher Rf value (0,65), a slightly pungent substance showing a reaction characteristic of a capsaicin,

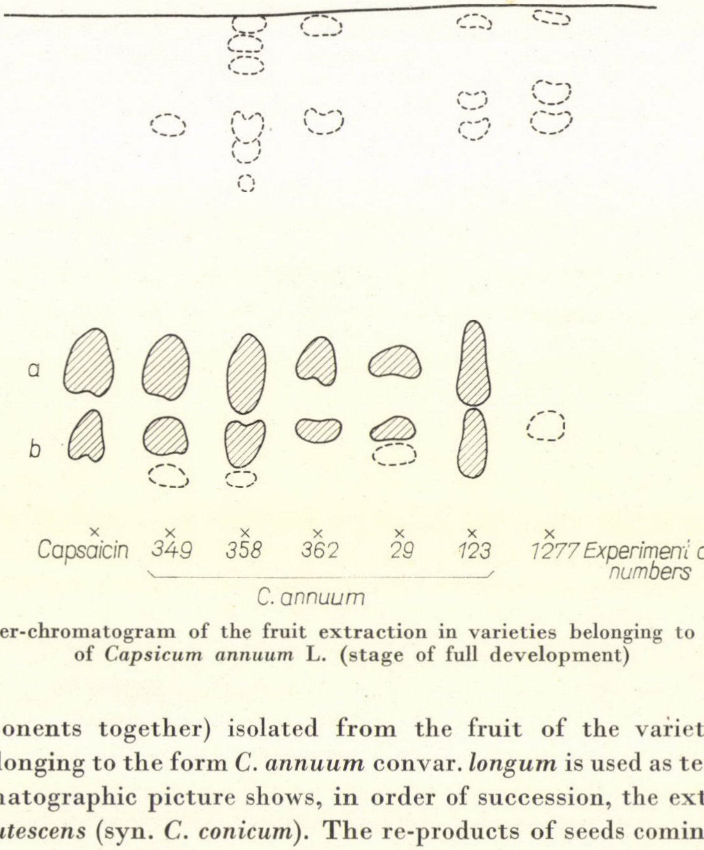

Fig. 1. Layer-chromatogram of the fruit extraction in varieties belonging to the category of *Capsicum annuum* L. (stage of full development)

could also be observed; in other samples, between the capsaicins and in their vicinity, a substance of non-pungent character could be evinced. At the end of the chromatogram the layer-chromatogram of the fruit of *C. pubescens* (125) can be seen which agrees with the quantitative and qualitative conditions of capsaicins *a* and *b* as observed with the varieties *C. annuum*.

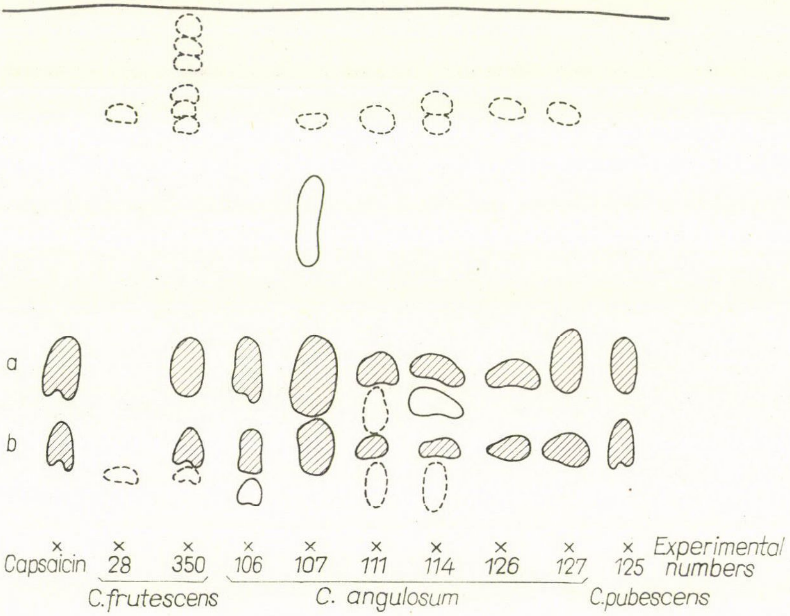

Fig. 2. Layer-chromatogram of the fruit extraction in some *Capsicum* species (stage of full development)

Conclusions

The alkaloids are divided into three groups by Hegnauer (1964). He calls the first group that of protoalkaloids or biogen amines; to which might also be taken the capsaicin, as a phenylalkilamine derivative. Up to recent times the opinion has prevailed that of this compound-group the capsaicin occurs alone in paprika; moreover, some authors (like e.g. Newman 1953) have established as a final statement, on the basis of several decades' experience "that the characteristic pungency of *Capsicum* is due to one substance only: the capsaicin".

As against this statement a few and mainly methodical publications (Holló *et al.* 1957, Kraus 1961), have hinted that in the paprika, besides capsaicin, other substances are also present showing similar reaction, though up to now nobody has isolated from the paprika a substance being similar to capsaicin. For this reason is the work of Kosuge *et al.* (1958) of great importance; it has proved that in the japanese pungent paprika and thus, presumably, in other pungent varieties belonging to the category of *Capsicum annuum* L. at least two pungent substances have to be reckoned with. This was confirmed by Tyihák *et al.* (1966) and later by Friedrich *et al.* (1965). Besides capsaicin being considered so far homogeneous, it is worth while mentioning the occurrence of substances practically non-pungent, however, of protoalkaloid character (Tyihák *et al.* 1966). The investigations carried out so far also support the point of the lecture delivered on the occasion of the International Alkaloid Symposium, Halle (Tyihák *et al.* 1965) according to which the *Capsicum annuum* L. might be also included among the other alkaloid containing plants.

On the basis of the results expounded in the present report, it can also be stated that in the fruit of other species of the *Capsicum* genus there are also present several pungent substances both in the stage of full development and in that of entire biological maturation. The greatest variedness has been observed when examining the fruit of *C. angulosum*.

The test-material of our report has been made up by drug mass-substances. Our informative individual examinations show considerable chemical divergencies within the species and variety, respectively. It is hoped that the individual examinations will submit a basis for producing a great number of chemical variants.

From practical point of view our investigations show that for producing the two pungent components all the varieties of pungent flavour belonging to the category of the *C. annuum* L., are suitable, but — of course — the ones that possess a high content of total capsaicin can mostly be taken into consideration.

Out of other species of the *Capsicum*-genus a thorough studying of the fruit of *C. angulosum* (syn. *C. pendulum*) seems to be the most effective in the future because it is outstanding in its total capsaicin content and calls the attention to the variation of several materials of protoalkaloid content.

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EFFECT OF LOW TEMPERATURE ON THE ION UPTAKE BY RICE ROOTS

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Short experiments have been made with excized rice roots. The absorptions of ions at lower temperature were found to differ from one another. Whereas phosphate and bromide uptake decreased with temperature in every case, rubidium absorption was found to rise again below 8° C. A cold shock (sudden changes in temperature) is presumed to be responsible for this unusual result. The intensity of this effect could be reduced by gradual cooling. Cold influence of short duration did not cause irreversible physiological changes in intact plants, but after 3 days growth disturbance of the roots and shoots could be observed.

Introduction

It is widely known that environmental factors, such as temperature, pH, light effects, etc. affect the absorption by plants of nutrients to a considerable extent (LYCKLAMA 1964, SARIC—CURIC 1963, SUTCLIFFE 1962, ZHURBITZKY—SHTRAUSBERG 1958). Of the external factors, temperature has a particular role to play in the case of certain frost sensitive plants, including rice which requires the whole cultivation period to be completely frost free.

It is possible to grow rice to about the 30th parallel (Uruguay) in the Southern hemisphere and to about the 47th parallel (Hungary) in the Northern one. However, it may occur inside these zones that low temperature may directly or indirectly do harm to the rice. Within the temperate belt the so-called minimum temperature for germination which is generally ranging between 10 to 12° C has an important part in deciding the time of sowing the rice (KÜRTEN 1954). There is no doubt that this knowledge is immensely important to people growing rice in the border areas where rice can still be grown, but it is not certain that the minimum temperature required for germination and absorption of nutrients is identical for rice. It is therefore necessary to examine this problem from a practical point of view, but at the same time it is also interesting from a theoretical viewpoint, since it can offer valuable information towards solving certain problems connected with the absorption of nutrients.

Material and Method

The plants (a sort of *Oryza sativa* var. *japonica*) were grown from 10—12 days in water culture. The method had already been described in detail in a previous paper (FRIED *et al.* 1965). The excised roots were kept in distilled water during 30 minutes before being placed in the absorption solution. The experiments of short duration at different temperatures were carried out with the help of radioactive (P-32, Rb-86 and Br-82) isotopes.

The concentration of the absorption solution of KH_2PO_4, NaBr was 10^{-4} and RbCl — 5×10^{-4} M with a pH of 5.5. After the absorption period the excised roots were washed with distilled water according to the method of FRIED and his coworkers (1961), and placed in an aluminium dish. The quantity of ions absorbed was determined by measuring the root activity directly, and the results are given in micro mole/g dry weight.

Several times curves were made from the ion uptake by excised roots and all solutions were aerated during experiments. The results obtained in the five independent series are in essence identical and the average values are given.

Results

According to Figures 1 and 2 phosphate and bromide uptake by rice roots rises or decreases depending, as expected, on the temperature. These results are in full agreement with data published by other authors about experiments made with the roots of other plants (CSEH—BÖSZÖRMÉNYI 1964, LYCKLAMA 1964, OBERLÄNDER 1963, ZHURBITZKY—SHTRAUSBERG 1958). The absorption of Rb at low temperature is completely different as indicated in Figure 3. It can be seen from the Figure that the uptake of rubidium decreases to about 8° C, but it continues to increase again towards 0° C.

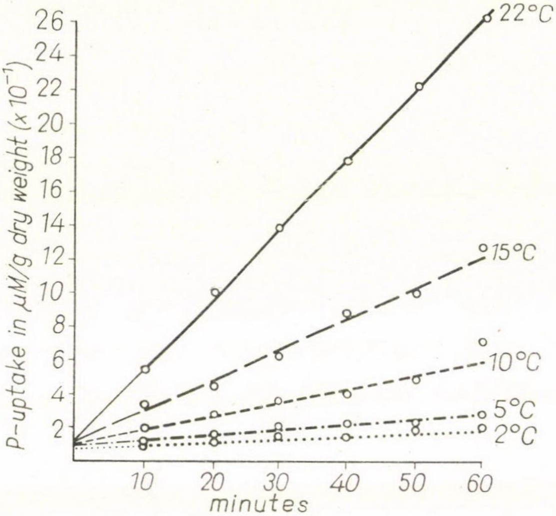

Fig. 1. Effect of temperature on phosphate uptake from 10^{-4} M KH_2PO_4 solution by excised rice roots

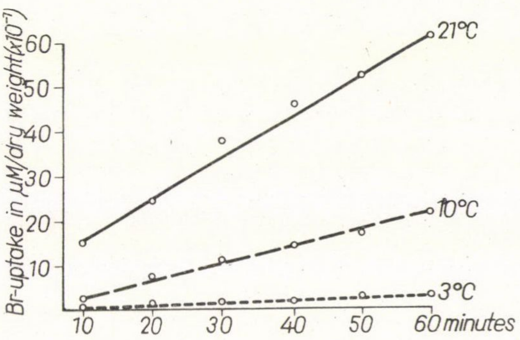

Fig. 2. Effect of temperature on bromide uptake from 5×10⁻⁴ M RbCl solution by excised rice roots

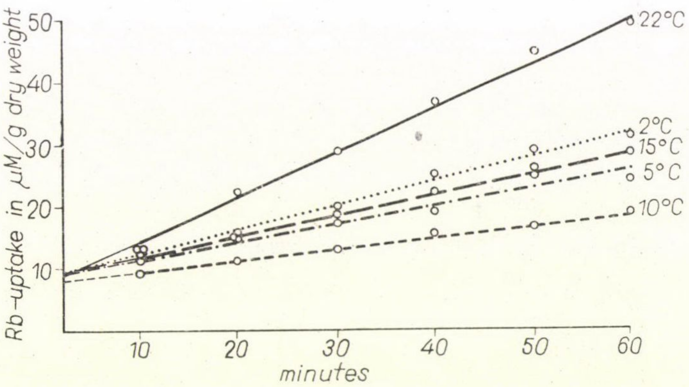

Fig. 3. Effect of temperature on rubidium uptake from 5×10⁻⁴ M RbCl solution by excised rice roots

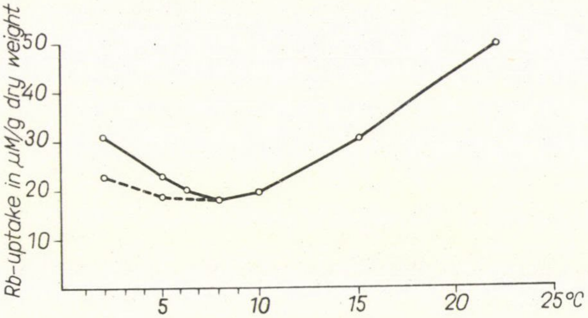

Fig. 4. Rubidium uptake from 5×10⁻⁴ M RbCl solution by excised rice roots after 60 minutes. (-------- gradual cooling, ——— rapid cooling)

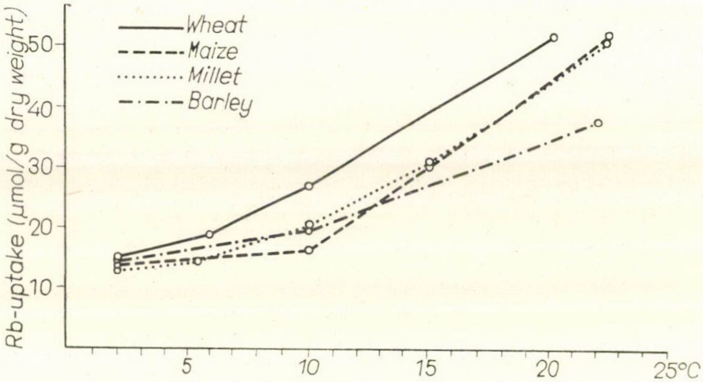

Fig. 5. Rubidium uptake from 5×10^{-4} M RbCl solution at different temperatures by wheat, maize, millet and barley roots

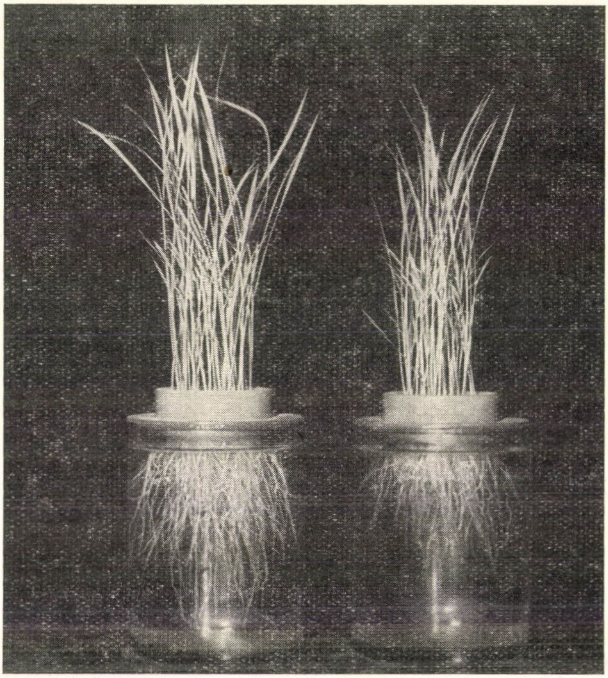

Fig. 6. Effect of cooling of short duration on the growth of the rice plants. (At left control, at right cooling)

In this process it is mainly the sudden changes in temperature that play a major part; this is indicated by the fact that gradual cooling for 2 to 3 hours could reduce this effect (Fig. 4).

Since this anomalous symptom at low temperature could only be detected in the uptake by rice of the Rb ion, it seems to be a very specific one. Although we did not socceed in detecting the cold effect under similar conditions in some other plants (Fig. 5), the question of its occurrence cannot be considered as settled.

According to our experiments made with intact plants cold treatment of short duration causes no irreversible physiological changes for, as a result of cooling (2 °C) during one and a half hours, growth-disturbance can be found in the roots and shoots after three days (Fig. 6).

Conclusions

As far as we know there is no reference in literature to the rice to be an exception to the above-mentioned general rule, however, there are data that might help to give an explanation for this unusual result. It is known, that, following sudden changes in temperature, a so-called shock effect can also develop in plants and this can, for example, bring about a sharp change in the intensity of respiration (Runkel 1962). It has also been observed in microorganisms that under such conditions the permeability of the cell membranes is increased remarkably (Strange 1964).

This may well be the case in rice roots where, as a result of the shock effect at 8° C, the membranes are supposed to be easier permeated and this makes it possible for the Rb ions to reach the cells in a quantity larger than expected.

We think that our results can serve as interesting data to be used for research on the mechanism of ion uptake and on the structure of membranes. The ions possessing a common carrier are presumed to behave in a similar manner.

It can also be concluded from our data that at 10° C to 12° C, that is, the minimum temperature for the germination of rice seeds, the effect of cold shock cannot be experienced. So normal absorption is possible at this temperature, but the rate is lower.

Acknowledgements

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SOME ASPECTS OF HYBRIDIZATION OF TRITICUM WITH AGROPYRON AND SECALE

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By single crosses of *Triticum* with *Agropyron intermedium* H. we obtained perennial plants in F_2—F_4 most of which gave two yields annually. These progenies served as basic material for forage cereals. Complex crossing may result in hybrids of annual type, highly resistant to rust infection. This was proved by artificial brown rust infection and by testing resistance to yellow rust under natural conditions.

Complex crossing of *Triticum* × *Secale* hybrid derivates with the indigenous forms of *Triticale* produced also rust-resistant progenies that were early maturing and completely fertile. For identifying new amphidiploid forms there has also been set up rich breeding material.

Wheat × *Secale* hybrids in F_1 when crossed with domestic amphidiploids have resulted in rich breeding material which may serve as basis for identification of further amphidiploid forms.

Introduction

In the scheduled breeding program of the Research Institute for Cereals and Technical Plants at Fundulea particular attention has been devoted to ensuring valuable breeding stocks through the hybridization of wheat with *Agropyron* and rye.

Triticum L. × *Agropyron intermedium* H. *hybrid*. The hybridization of wheat and *Agropyron* was initiated with the purpose of improving some physiological properties of wheat. Valuable traits of *Agropyron* were intended to transfer by intergeneric crosses to wheat so that frost and drought hard annual wheat forms with increased resistance to cryptogamic diseases might be obtained, as well as perennial fodder cereals suitable for cropping in mountainous areas and on eroded soils which are otherwise inappropriate for common wheat culture.

In the USSR Tsitsin's achievements in crossing wheat with *Agropyron* have proved fairly advantageous to Soviet agriculture and the promising varieties that have been produced recently (by Lapchenko in the USSR and Rusmini in Italy) seem to confirm both the theoretical and practical importance of the intergeneric crosses in plant-genetics (Baenziger 1962, Elliot 1958, Lobashev 1963, Rusmini 1958a, 1958b, 1962, Tsitsin 1963a, 1963b, 1963c, 1963d).

Triticum **L. ×** ***Secale cereale hybrid.*** Valuable properties of rye, such as high germinative ability in the field, appropriate seed setting under adverse moisture and temperature conditions, resistance to frost and cryptogamic diseases, high yielding ability on soils of low quality and the preservation of germinative ability for a long time were attempted to transfer to wheat (YAKIMOVICH 1960, SUKHORUKOV 1960).

The highly frost-resistant variety *Lutescence 203*, now grown in large areas was produced by wheat and rye crosses in the USSR. Amphidiploid forms ($2n = 56$) involving the combined properties of wheat and rye have been utilized in breeding for new wheat varieties in many countries (BLEDSEE 1932, CAUDERON—SAIGNE 1961, FLORELL 1931, KISS 1962, KROLOW 1963, LOGODINOVA 1962, LYUBIMOVA 1960, NAKAJIMA 1961, PISSAREV 1955, PRIADCENCU 1952, 1963a, 1963b, SIMONET 1957, SMITH 1942, ZENNYOZI 1964).

Material and Method

This paper includes the results of several experiments involving different test-plants. In addition to presenting the results the applied material and method is also touched.

Domestic and imported varieties of the species *T. aestivum* and *T. durum* were used as maternal parents. Pollen providing plants were first obtained from a local population of *Agropyron intermedium*, then from clones picked out of the entities of local and imported *Agropyron* varieties.

Method applied to obtain the valuable hybrid derivates shown in Fig. 1 was the following: resultant seeds of the wheat × *Agropyron* crosses were planted in plots, each 20 m long and of 4 rows. Spacing rate was 1 m. Various species and varieties of wheat as well as hybrids of interspecific and intergeneric crosses were planted in the neighbouring plots of the same size. This way was used in exposing the florets of the hybrids in F_1 to free-pollination.

F_2 and F_3 yields were planted with the same method thus the improvement of the hybrids was ensured by simple and complex directed crosses. Hybrid material in the progenies was divided into distinct morphological and physiological classes (Fig. 2). Among the complex hybrids including 3 or 4 derivates the following combinations were of interest:

a) With three hybrid derivates: F_1 (*T. aestivum* × *A. intermedium* F_3) × *Bezostaya* 1^2; F_1 (*T. aestivum* × *A. intermedium* F_4) × *Magdalena* × *Bezostaya 1*; F_1 (*T. aestivum* × *A. intermedium* F_4) × *Capelle* × *Bezostaya 1* and F_1 (*T. aestivum* × *A. intermedium* F_4) × *Magdalena* × *T. durum*.

b) With four hybrid derivates: F_1 (*T. aestivum* × *A. intermedium* F_2) × *T. durum*^{2} × *San Pastore*; F_1 (*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *San Pastore* × *Bezostaya 1*; F_1 (*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *Bezostaya 1* × *San Pastore* (Fig. 3).

In producing the first hybrid generation of *T. aestivum* × *Secale cereale* 30 ecologically highly differing wheat varieties of the species *T. aestivum* (Korean, Soviet, US and Italian) as well as 5 varieties and lines of the species *T. durum* and the first interspecific generation of *T. aestivum* were used as maternal partners. Diploid rye variety ($2n = 14$) and the "Fundulea-Genetics" tetraploid ($2n = 28$) served as pollen providing plants.

With the aim to produce simple and complex hybrids we drew into the investigations two local forms of Triticale, i.e. a highly rust-resistant of intermediate type and one with grains of common type, the susceptibility of which supplied basis for comparative resistance-studies.

Results and Discussion

A) 1. *Triticum* L. × *A. intermedium* H. *crosses.* Under somewhat wet steppe conditions the hybridization of wheat with *Agropyron* turned out fairly successful displaying 7 and 21.9 per cent seed setting respectively when *T. aestivum* and *T. durum* were involved. Seed setting percentage ranging up to

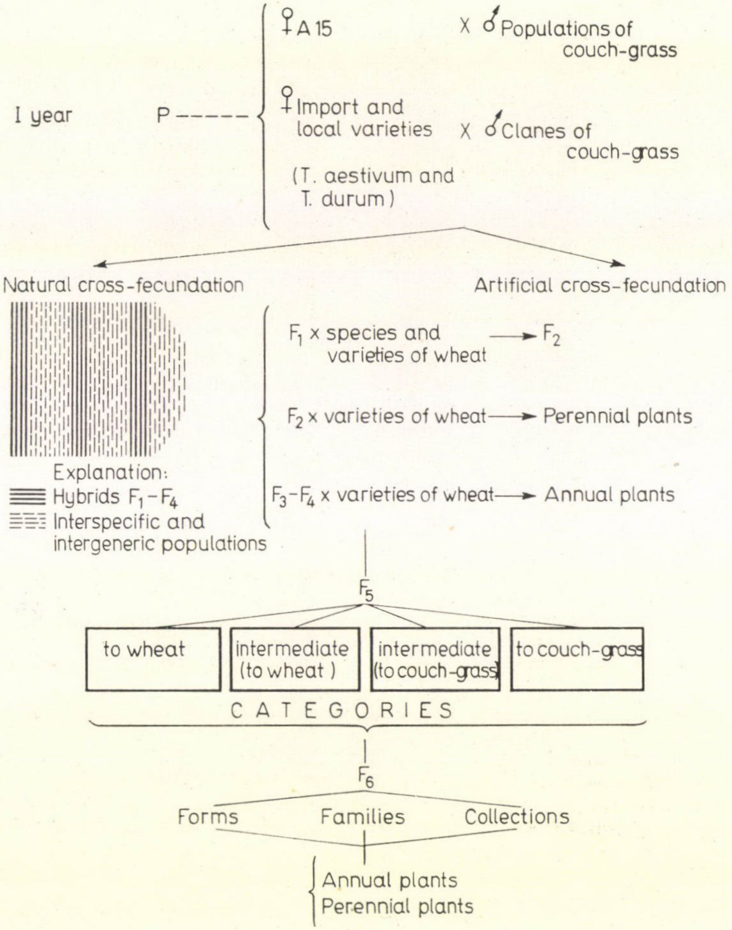

Fig. 1. **Scheme of the wheat cross with *A. intermedium***

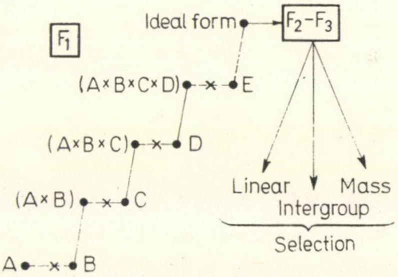

Fig. 2. **Scheme of the formation of complex hybrids, with 3 and 4 hybrid derivates**

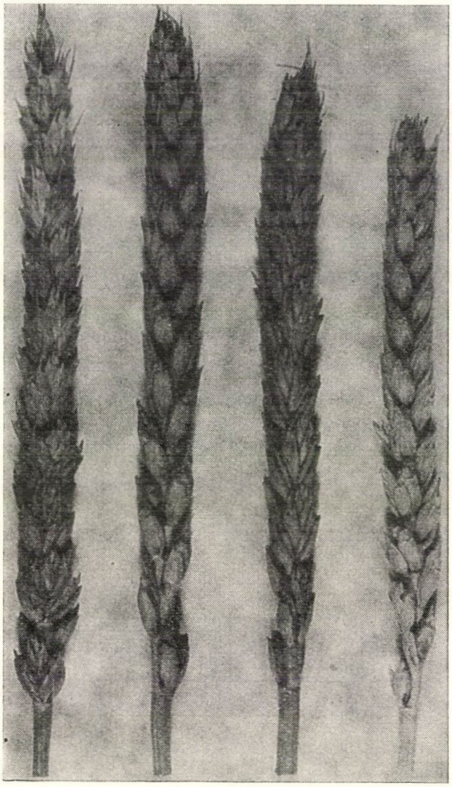

Fig. 3. Forms of the *Triticum* × *A. intermedium* hybrid in F_3 and F_4, proceeded from complex crosses

34.1 per cent could be found with certain lines of hard wheat. Under dry steppe conditions and using hard wheat proceeded from irradiated seeds as maternal plants 4.16 per cent seed setting was observed (Table 1).

2. *Fertility of the hybrids.* These F_1 hybrids are usually sterile and cannot be easily back-crossed with the parents and other species or related genus. When F_1 hybrid was back-crossed with *A. intermedium* 3.36 per cent seed setting was obtained and by crossing it with *T. aestivum*, *T. durum* and diploid rye the resultant seed sets were found in 2.03, 1.72 and 0.12 per cent respectively (Table 2).

In performing the fertility analysis 99.67 per cent of 28,663 ears in F_1 was found completely sterile, while only 0.33 per cent was indicated as containing 1—6 seeds (Table 3).

In F_2 the segregation and fertility were found sufficient, varying and irregular. As much as 20—25 per cent of the plants are more or less similar to the cultivated forms and remain completely uninfected by cryptogamic diseases. At the same time a large number of F_2 entities possessed the negative

Table 1

Seed set per cent at cross of Triticum L.×A. intermedium H.

Combinations	Examined ears, numbers	Crossed flowers, numbers	Grains gained, numbers	Seed set %
In wet steppe				
T. aestivum×*A. intermedium*	66	1891	133	7.03
T. durum×*A. intermedium*	313	9243	2026	21.92
T. durum v. *melanopus* N°1×*Agr. intermedium*	3	94	—	—
T. durum v. *melanopus* N°2×*Agr. intermedium*	6	180	1	0.55
T. durum v. *melanopus* N°3×*Agr. intermedium*	11	322	3	0.94
T. durum v. *melanopus* N°4×*Agr. intermedium*	14	398	78	19.60
T. durum v. *melanopus* N°5×*Agr. intermedium*	15	403	101	25.10
T. durum v. *melanopus* N°6×*Agr. intermedium*	52	1446	397	27.50
T. durum v. *melanopus* N°7×*Agr. intermedium*	29	874	298	34.10
In dry steppe				
T. aestivum×*A. intermedium*	420	2488	115	1.35
T. durum×*A. intermedium*	65	1360	13	1.00
T. durum irradiated with thermic neutrons×*A. intermedium*	60	1200	50	4.16
(*T. aestivum*×*A. intermedium* F_2)×*T. aestivum*	256	5220	290	5.50
(*T. aestivum*×*A. intermedium* F_2)×*T. aestivum*^{2}	233	4640	684	14.70
(*T. aestivum*×*A. intermedium* F_2)×*T. durum*	77	1540	140	9.10
(*T. aestivum*×*A. intermedium* F_2)×*T. durum*^{2}	42	800	97	12.10

Table 2

Seed set per cent at controlled back and top cross of the Triticum L.×A. intermedium H. hybrid in F_1

Combination	Examined ears, numbers	Crossed flowers, numbers	Grains gained, numbers	Seed set %
(*T. aestivum*×*A. intermedium*)×*T. aestivum*	25	836	17	2.03
(*T. aestivum*×*A. intermedium*)×*A. intermedium*	14	506	17	3.36
(*T. aestivum*×*A. intermedium*)×*T. durum*	8	290	5	1.72
(*T. aestivum*×*A. intermedium*)×*Secale cereale* (diploid)	25	340	1	0.12

properties and characters of *Agropyron*, such as late maturity, thin and elongated seed, fragility of the rachis and were perennial (Table 4).

Number of fertile ears on the F_2 plant averaged 53. The following variation in the number of seeds per ear was observed: 1—20 seeds in 86.9 per cent of the ears; 21—40 seeds in 11.9 per cent and 41—70 seeds in 1.2 per cent (Table 5).

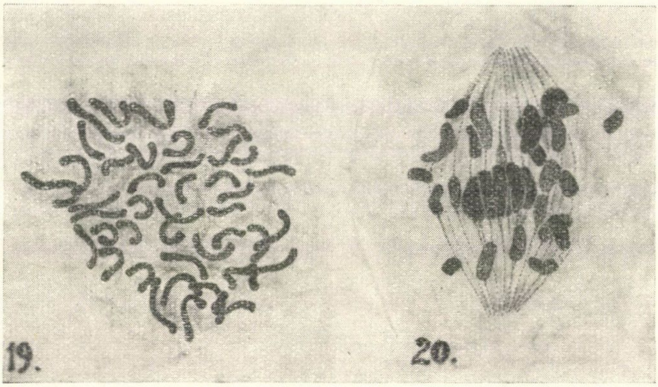

Fig. 4. Caryology of the hybrid forms of *Triticum* and *A. intermedium* of aestivum type in F_2. (19 = somatic metaphase, 2n = 42; 20 = heterotypical anaphase advanced chromosomes)

3. *Cytological studies.* In the plants of the first hybrid generation the following aberrations of the meiotic division were observed: appearance of necrotic nuclei, slight appearance of synapses, irregular distribution of the chromosomes in the anaphase followed by lack of chiasma. In F_2 the number of aberrations met in the process of the meiotic division was lower. Pollen seeds remained sterile in 69 per cent (Table 6, Fig. 4).

Table 3

Fertility at free recross of the Triticum L. × A. intermedium H. hybrid in F_1

Hybrids	Generation and planting year	Bushes		Ears			Grains	
		Total	Fertile %	No.	Fertile %	No. of analysed fertile ears	Average number of grains per ear	Variation of the grain number in an ear
A 15 *(T. aestivum)* × local *A. intermedium*	F_1/1956	277	9.7	24 206	0.24	83	1.5	1—5
Local *T. durum* × local *A. intermedium*	F_1/1961	80	13.8	4 457	0.69	48	1.6	1—6
S =	—	357	10.7	28 663	0.33	131	1.55	1—6

Table 4

Characters and properties of the plant and ear of Triticum L.× A. intermedium H. in 1962

Value / Property	Generation	$\bar{x}$	$s_{\bar{x}}$	s	P	GC	
						P = 5%	P = 0.1%
Height of the bush (cm)	F_1	124.2	± 3.2	16.0	2.6	117.6 130.8	112.3 136.1
	F_2	100.5	± 1.1	10.7	1.1	98.3 102.7	96.8 104.2
Length of the ear (cm)	F_1	14.88	± 0.5	2.3	3.0	13.85 15.91	13.02 16.74
	F_2	17.99	± 0.2	2.5	1.4	17.60 18.38	17.31 18.67
Width of the ear (cm)	F_1	3.74	± 0.1	0.8	4.2	3.54 3.94	3.57 4.11
	F_2	5.21	± 0.09	0.9	1.7	5.03 5.39	4.91 5.51
Thickness of the ear (cm)	F_2	5.10	± 0.2	0.9	3.5	4.69 5.51	4.36 5.84
	F_1	6.83	± 0.1	1.0	1.4	6.64 7.02	6.49 7.17
Number of spikelets in the ears	F_1	19.28	± 0.6	2.9	3.0	18.05 20.51	17.05 21.51
	F_2	18.30	± 0.3	3.4	1.8	17.71 18.89	17.29 19.31
Number of flowers in the spikelets	F_1	6.08	± 0.2	1.0	3.3	5.67 6.49	5.34 6.82
	F_2	5.92	± 0.1	0.9	1.3	5.73 6.11	5.58 6.26
Number of articulations on the rachis	F_1	16.20	± 0.4	2.2	2.7	15.38 17.02	14.72 17.68
	F_2	15.30	± 0.3	2.7	1.8	14.71 15.89	14.29 16.31

4. *Qualitative properties of hybrids.* Exterior of ears and plants in F_1 is of intermediate character but slightly resembling *Agropyron*. The following segregations for the most important properties of the hybrids in F_1 were obtained:

a) plant height, number of spikelets in the ear, ear-form as intermediate character,

Table 5

Quantitative characters of the Triticum L.×A. intermedium H. hybrid in F_2
(n = 100)

Value Property	$\bar{x}$	$s_{\bar{x}}$	s	P	GC	
					P = 5%	P = 0.1%
Number of fertile ears	27.90	± 1.3	13.4	4.6	25.35 30.47	23.50 32.30
Number of grains in the ear	13.87	± 0.5	5.7	3.6	12.88 14.82	12.18 15.56
Total weight of the grains on the plants (g)	9.85	± 0.5	5.1	5.0	8.80 10.80	8.16 11.54
Total weight of the grains on the ear	0.23	± 0.01	0.1	4.3	0.22 0.24	0.20 0.26
Weight of 1000 grains (g)	15.94	± 0.3	2.1	1.6	15.35 16.53	14.93 16.95
Length of the grain (mm)	7.87	± 0.08	0.8	1.0	7.72 7.92	7.60 10.14

b) ear-thickness, ear-width, number of florets in the spikelet, width of glume as wheat-resembling character,

c) ear-length, glume-length and glumela-length as luxurious characters.

Through complex hybridization large variability for precocity, small size and rust resistance was obtained and also high variability for the following ear-properties was observed: cylindrical form with more or less dense spikelets, also cylindrical but vaxy-coated, lax and of speltoid type, white, red, black, dappled, spotted, reddish, slightly reddish colours, presence of arista, semi-aristated ears, multifloral spikelets, less frequently ramified ears, porosity of the glume, hairy glumae and glabreous glumae, each in 50 per cent of the ears, respectively.

5. *Agronomic evaluation.* The hybrids in F_1 are highly resistant to frost, drought and rust, are perennial and display tillers of semi-erected type. In comparison with the parental forms their earing-date is intermediate and quite up to late autumn they preserve their green leaves uninfected by rust. They are greatly tillering, setting up to 200 suckers per plant.

At the grouping of the 109 hybrid forms of *Triticum*×*A. intermedium*, 34 per cent of the hybrids was found completely resistant to yellow rust when classified for resistance-degree, and 43.3 per cent proved slightly susceptible. At the same time the hybrids proved more susceptible to the attack by brown rust. As much as 61.5 per cent of the analysed forms turned out slightly susceptible to brown rust (Table 7).

Table 6

Cytological aspects of the Triticum L.×A. intermedium H. hybrid in F_2

a) Aberrations of the archesporial cells

Number of investigated cells	Aberrations						Cells and aberrations					
	%	Per cent amplitude of the normal cells	Phycotic nuclei		Micronuclei		Eliminations of micronuclei		Polynucleic cells		Gigantic cells	
			Total	%	Total	%	Total	%	Total	%	Total	%
21 000	38.3	4—98	4378	20.7	3301	15.8	94	0.5	201	1.0	67	0.3

b) Aberrations of the heterotypical division

Number of investigated cells	Aberrations		Cells with aberrations																	
	%	Per cent amplitude of the normal cells	Metaphase		Anaphase		Retarded chromosomes in the telophase													
							1		2		3		4		5		6			
			Total	%	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%	Total	%		
6815	4.9	72—99	123	1.9	15	0.2	90	1.3	38	0.6	17	0.2	26	0.4	14	0.2	6	0.1		

c) Fertility of the pollen grains F_2

Character	Underdeveloped		Sterile		Fertile		Amplitude of the fertility per cent
No. of observed pollen grains	Total	%	Total	%	Total	%	
12 112	3678	30.4	7467	61.9	967	8.0	0.8—37.6

The rust resistant hybrid material was submitted to periodical selection. Rust-resistant hybrid derivates: 108 forms proceeded from complex crosses were artificially infected so that we should study their behaviour to yellow rust infection. It was also investigated how they reacted to brown rust infection under natural conditions. Rust-susceptible variety Concho was used as control. The investigations revealed high resistance of the complex hybrids to rust, except for the F_2 (*Triticum*×*Agropyron* F_2)×*T. durum*×*Skorospelka*×*San Pastore* which proved highly susceptible to rust infection. In general the hybrids were found resistant rather to yellow rust and quite susceptible to brown rust (Table 8).

Table 7

Grouping of the hybrid forms of Triticum L. × *A. intermedium H. according to their degree of resistance to rust* (F_2/1965)

Form No.	Percentage of attack							
	yellow rust							
	0		0—10		15—25		above 25	
	No.	%	No.	%	No.	%	No.	%
109	37	34.0	38	34.8	18	16.5	16	14.6

Form No.	brown rust							
	0		0—10		15—25		above 25	
	No.	%	No.	%	No.	%	No.	%
109	—	—	15	13.7	63	57.8	31	28.4

Table 8

Rust resistance of the Triticum L. × *A. intermedium H. hybrid in* F_2 *established by artificial infections*

Hybrid combination	Percentage variation of the attack	
	Yellow rust (*P. glumerum*)	Brown rust (*P. triticinae*)
Susceptible variety (Choncho)	60—100	10—80
(*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *Bezost. 1* × *S. Pastore*	0— 45	15—25
(*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *S. Past.* × *Bezost. 1*	0— 10	20—60
(*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *Sc. 3* × *S. Pastore*	90	25
(*T. aestivum* × *A. intermedium* F_2) × *T. durum* × *Etoile de Choisy* × *Bez. 1.*	0— 30	12—60
(*T. aestivum* × *A. intermedium* F_2) × *T. durum*^{2} × *S. Past.*	0— 40	10—25
(*T. aestivum* × *A. intermedium* F_2) × *T. durum*^{2} × *Bez. 1.*	0— 35	10—70
(*T. aestivum* × *A. intermedium* F_2) *1961 fam. 19* × *Bez. 1*^{2}	0— 40	12—60
(*T. aestivum* × *A. intermedium* F_3) *1961 fam. 5* × *Bez. 1*^{2}	0— 10	10—70
(*T. aestivum* × *A. intermedium* F_4) *1961 fam. 531* × *Magdalena* × *Bez. 1*	0— 10	10—20
(*T. aestivum* × *A. intermedium* F_4) *1961 fam. 538* × *Capelle* × *Bez. 1*	0— 40	10—60
(*T. aestivum* × *A. intermedium* F_4) *1961 fam. 533* × *Magdalena* × *Bez. 1*	0— 40	10—70

Table 9

Seed set per cent at Triticum L. × Secale cereale crosses

♀ *T. aestivum* (varieties)	Petkus diploid rye ♂		
	Crossed flowers, numbers	Grains gained, numbers	Seed set %
Sani Si	400	124	31.0
RPC 17	608	140	23.0
RPC 16	298	55	18.4
RPC 24	100	16	16.0
Skorospelka 3	310	36	11.6
RPC 21	98	11	11.1
RPC 27	100	10	10.0
Triumph	1 122	111	9.0
RPC 28	502	48	9.6
RPC 20	200	15	7.5
Ju-Tzi-Me	108	8	7.4
RPC 14	504	37	7.3
RPC 34	300	22	7.3
RPC 33	200	13	6.5
Rucsan 3	508	32	6.3
RPC 21	495	31	6.2
Nun da 1	508	27	5.3
Autonomia	118	6	5.0
RPC 29	208	10	4.8
RPC 22	464	15	3.2
RPC 19	108	3	2.7
Tevere	222	6	2.7
ICA 457 B	104	2	1.9
RPC 31	104	1	0.9
Mentana	118	1	0.9
Oro	120	1	0.8
IBO 1373	565	—	—
S =	8 492	781	9.2
(*T. aestivum* × *T. aestivum* F_1)	1 937	42	2.1
T. durum	180	—	—
Total	10 609	823	7.7

Hybrid derivates for fodder wheat: For this purpose there have been used only simple crosses with two hybrid derivates in order to maintain the perennial property of the hybrids. Through rigorous selection 40 plants in F_2 were

Table 10

Seed set per cent at Triticum L.$\times$Secale cereale crosses

♀ *T. aestivum* (varieties)	Tetraploid rye ♂		
	Crossed flowers, numbers	Grains gained, numbers	Seed set %
RPC 31	100	5	5.0
Ju-Tzi-Me	114	5	4.4
RPC 16	106	4	3.6
RPC 24	98	3	3.0
Etoile de Choisy	1300	39	3.0
Skorospelka 3	714	10	1.4
RPC 28	102	2	1.9
ICAR 2	100	1	1.0
RPC 17	104	1	0.9
RPC 29	0	0	0
RPC 27	0	0	0
RPC 21	0	0	0
RPC 19	0	0	0
RPC 34	0	0	0
Rucsan 3	0	0	0
IBO 1373	0	0	0
Guilliani	0	0	0
San Pastore	0	0	0
Mentana	0	0	0
Tevere	0	0	0
Nun da 1	0	0	0
Oro	0	0	0
ICA 495 C	0	0	0
ICA 457 B	0	0	0
Galitcaia	0	0	0
S =	2738	70	2.5
(*T. aestivum*$\times$*T. aestivum* F_1)	1348	16	1.1
T. durum	1200	18	1.4
Total	5286	104	2.0

selected in 1964. These plants were completely free of cryptogamic infection, were of perennial character and yielded twice a year. Selecting for fodder wheat is extremely difficult. Only 140 progenies out of 749 plants in F_2, with seeds more or less close to those of the *T. aestivum* species could be identified in 1965 and are to be studied in the forthcoming generations, too. In most cases the seeds of the fodder type are intermediate, i.e. long and thin seeds. Only 300 out of 1000 plants in F_3, resembling *T. aestivum* species could be isolated.

The endeavours as to obtain fodder grains have been recently extended by introducing experimentally 3000 progenies, highly perennial, of good yielding ability and more or less close to *T. aestivum* species in morphological aspect (Fig. 5a, b).

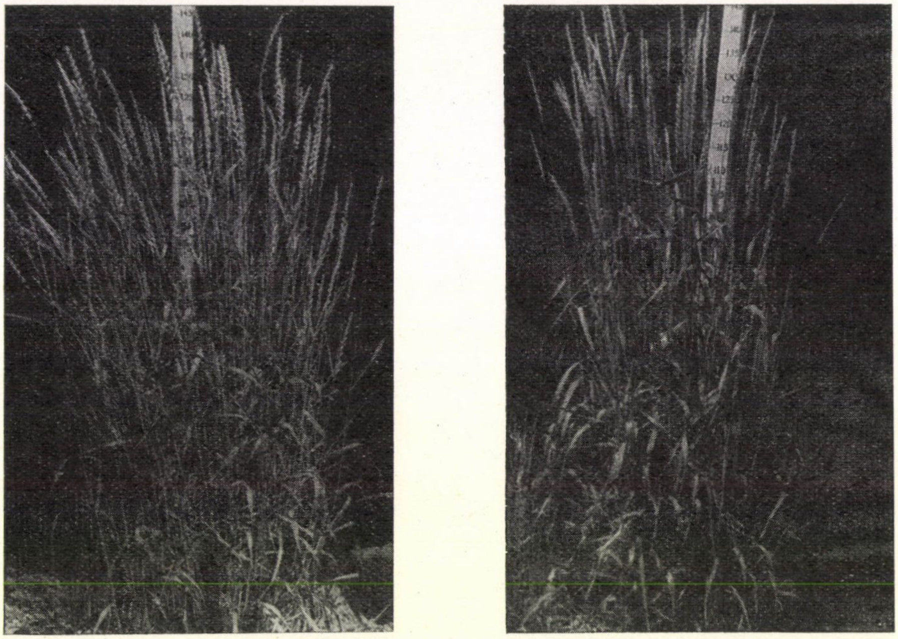

Fig. 5. Perennial forms of the *Triticum* × *A. intermedium* hybrid in F_2 and F_3, a) F_2; b) F_3

B) *Triticum* L. × *Secale cereale crosses.* Presumably due to the climatic conditions in the Bucharest region the wheat rye crosses were succesfull only in 9.2 per cent. Seed setting percentage of the wheat varieties ranged from 0.8 per cent to 31 per cent and it was the variety San-Si which exhibited the maximum 31 per cent. Minimum seed setting was found with numerous varieties including Italian ones and some showed nearly absolute incompatibility in their crosses with rye. In comparison with the *T. durum* species the varieties of *T. aestivum* can be better crossed under dry conditions. The use of the intraspecific hybrids in F_1 as maternal plant when crossing different wheat varieties resulted in no improvement of seed setting. This method can be applied for obtaining seeds when varieties which alone are not able to cross with rye *(San Pastore, IBO 1379)* are in question.

Table 11

Fertility and grain size of the T. aestivum × S. cereale in F_1

Characters	Parents and F_1	No.	Variability coefficients			
			$\bar{x}$	s	$s_{\bar{x}}$	P
Number of fertile or partially fertile ears	*Petkus rye*		26.70	6.53	1.30	4.86
	Triumph		14.72	3.15	0.78	5.29
	Triumph × rye	2069	111	—	—	—
	RPC 17		14.95	3.74	0.93	5.22
	RPC 17 × rye	768	9	—	—	—
Number of grains per ear	*Petkus rye*		37.94	7.87	1.55	4.08
	Triumph		39.83	4.81	1.20	3.01
	Triumph × rye		119/b 111 sp.	—	—	—
	RPC 17		38.34	5.86	1.61	4.17
	RPC 17 × rye	9	9/b	—	—	—
Length of the grain (mm)	*Petkus rye*		8.58	0.80	0.16	1.86
	Triumph		6.66	0.43	0.11	1.74
	Triumph × rye		6.56	0.98	0.15	2.28
	RPC 17		6.50	0.47	0.12	1.84
	RPC 17 × rye		6.20	—*	—	—
Width of the grain (mm)	*Petkus rye*		2.83	0.23	0.04	1.63
	Triumph		2.90	0.20	0.05	1.83
	Triumph × rye		2.11	0.43	0.05	2.32
	RPC 17		3.08	0.26	0.06	1.94
	RPC 17 × rye		2.40	—	—	—
Thickness of the grain (mm)	*Petkus rye*		2.87	0.28	0.05	1.95
	Triumph		3.13	0.27	0.07	2.23
	Triumph × rye		2.26	0.44	0.07	3.10
	RPC 17		3.13	0.44	0.11	3.51
	RPC 17 × rye		1.95	—	—	—

* Small number of individuals.

The use of the species *T. aestivum* in the intergeneric crosses of *Triticum × Secale* yielded better results than *T. durum*, provided it was used as seed parent. *T. durum*, however, displayed better performance as maternal parent in the crossings with tetraploid rye, compared with the intraspecific hybrid population of *T. aestivum* (Tables 9—10).

1. *Fertility of the hybrid.* Wheat × rye hybrid was highly sterile in F_1, i.e. it was only 1 per cent of the fertile ears which contained grains in a quantity of 1—3. In 1956 through the use of this system 561 grains were found in the otherwise highly sterile ears (Table 11).

Fertility of the ears of *Triticum* × *Secale* hybrids in F_2 displayed a highly varying pattern, i.e. 19 per cent of the ears turned out completely sterile, while 1—5 and 35—40 grains were found per ear in 44 and 37 per cent, respectively.

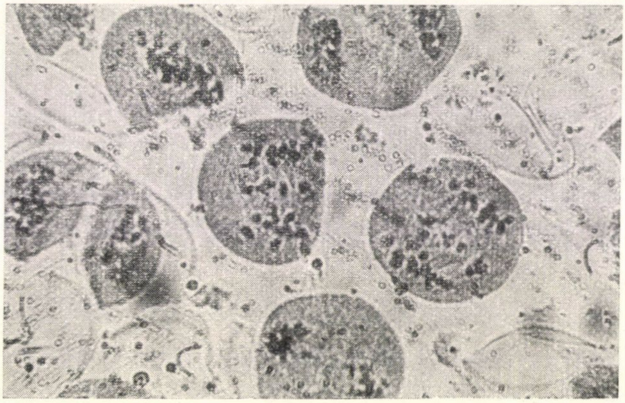

Fig. 6. The hybrid wheat × rye in F_1 heterotypical anaphasis with resting chromosomes F_1 (R.P.C. 17 × rye Petkus)

2. *Cytological studies.* The caryological studies revealed uniformity in the caryotype of the first hybrid generation, i.e. chromosome number in all investigated metaphases was found 2n = 28 (21 and 7 proceeded from wheat and rye, respectively). In studying the meiotic division of the combinations we observed high variability of different chromosomal aberrations (Fig. 6). Lowest number of aberrant cells was found with the Triumph variety when it was used as mother (Table 12).

3. *Quantitative and qualitative properties.* Numerous properties and characters of the hybrids in F_2, dominant or intermediate, were found to have been heredited from the pollen parent (rye) i.e. resistance to drought, strong tillering, half-erected form of the suckers, bluish colour of the leaves, porosity of the straw immediately below the ear, higher number of stalks and internodes, length and thickness of the internodes, length of the ear and number of the spikelets in the ear (Table 13).

Lower number of intermediate characters of the hybrid can be attributed to the maternal parent (wheat), i.e. straw-length, number of florets in the ear, length and width of the glume and seed-length. In some cases the quantitative characters of the hybrids are inferior to those of both parental forms (ear-width, short and wide grains) but it may also occur that they are superior (thickness of the straw, length of the arista, length of the spikelets). In phenotypic aspect the hybrids can be divided into the following classes:

a) Ears of Asian type — rigid and rough ears with diverging and frail arista. The grains strongly set in the husks can be treshed only with difficulty. Semi-aristed or erecting ears occurred rather seldom.

b) Ears of Indo-European type — identical with the common grains. The ears are aristated, semi-aristated and of erecting type, ears with white and red colours also appear.

c) Ears resembling dicoccum and spelta types — narrow and apiculate glume, rough and diverging arista. They are other than crop forms since their treshing is hard.

d) Hairy ear-neck — stalk with hairs 2—6 cm long occurring in various densities, highly specific trait of the rye plant. This type is rare with the forms near to the compactum type as opposed to its relative frequency in the forms with rye-resembling ear types.

4. *Agronomic evaluation.* The F_1 hybrids were highly frost resistant, strongly tillering and well developing in the field. These practical advantages might have been secured with difficulty by intraspecific crosses of *T. aestivum.*

Beginning with F_2 the isolation of valuable biotypes with good agronomic characters and properties was attempted so that we might draw them into the simple and complex crosses. In general the segregation in F_2 and in the following generations is highly irregular in either physiological or morphological aspect (Fig. 7).

Table 12

Meotic division of the Triticum

Combination	Investigated cells No	Cells				Irregularities of the premeotic division	
		normal		with irregularities		Micronuclei and necrotic nuclei and fragm. No.	%
		No.	%	No.	%		
Triumph × Petkus	530	233	44.0	297	56.0	38	7.2
RPC 17 × Petkus . .	390	108	27.7	282	72.3	—	—
Nun da 1 × Petkus	340	89	26.1	251	73.9	35	10.3
RPC 29 × Petkus . .	283	72	25.5	211	74.5	15	5.3
Tucsan 3 × Petkus .	108	19	17.6	89	72.4	—	—
Total:	1651	521	31.6	1130	68.4	88	5.3

By repeated crossing of wheat × rye hybrid in F_1 with valuable wheat varieties a wide range of hybrid grains was obtained, being completely fertile, rust-resistant, highly premature and of Indo-European and spelta types. Properties connected with yielding ability, i.e. large number of spikelets per ear, big, glassy and full grains were also involved.

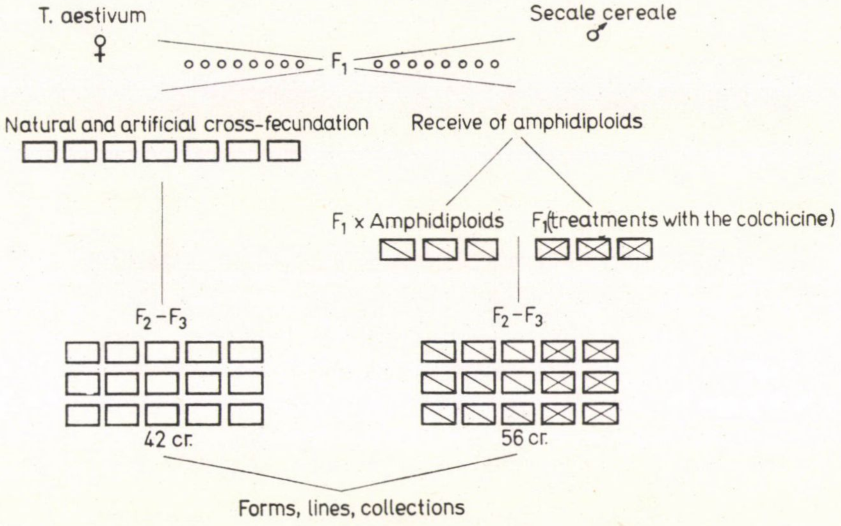

Fig. 7. Scheme of the wheat and rye cross

In order to produce new forms we crossed the wheat × rye hybrid in F_1 with two domestic forms of *Triticale.* First of them displayed high resistance to frost and cryptogamic diseases, was of intermediate type and somewhat

aestivum × *Secale cereale* (*Petkus*)

Aberrations of the meotic cells									
Metaphase		Anaphase		Telophase		Diades		Tetrades	
bivalent chromosomes		univalent chromosomes		bridges		micronuclei			
No.	%	No.	%	No.	%	No.	%	No.	%
75	14.2	67	12.6	—	—	39	7.3	78	14.7
81	20.8	68	17.4	36	8.7	45	11.5	54	13.8
56	16.3	53	16.1	36	10.5	29	8.6	42	12.1
42	14.8	50	17.6	—	—	40	14.1	64	22.6
28	25.9	25	23.2	6	5.5	7	6.5	23	21.3
282	17.1	264	15.9	7.6	4.6	160	9.7	261	15.8

Table 13

Characters of the ear at the hybrid F_1

Characters	Parents and F_1	Variability coefficients			
		$\bar{x}$	s	$s_{\bar{x}}$	P
Length of the ear (cm)	*Petkus rye*	12.48	1.52	0.30	2.41
	Triumph	10.52	0.64	0.16	1.52
	F_1 Trph.×rye	12.99	1.55	0.17	1.30
	RPC 17	8.40	0.89	0.22	2.61
	F_1 RPC×rye	11.68	1.00	0.16	1.36
Width of the ear (mm)	*Petkus rye*	6.95	1.10	0.22	3.16
	Triumph	9.10	1.36	0.34	3.73
	F_1 Trph.×rye	5.71	0.72	0.08	1.40
	RPC 17	9.70	1.10	0.27	2.83
	F_1 RPC 17×rye	4.78	0.98	0.16	3.34
Thickness of the ear (mm)	*Petkus rye*	7.95	0.88	0.17	2.13
	Triumph	10.05	0.87	0.21	2.16
	F_1 Trph.×rye	6.55	0.91	0.10	1.60
	RPC 17	9.68	1.10	0.27	2.78
	F_1 RPC 17×rye	5.55	1.01	0.17	3.07
Length of the arista (cm)	*Petkus rye*	6.12	1.07	0.21	3.43
	Triumph	7.78	1.11	0.27	3.47
	F_1 Trph.×rye	5.45	1.54	0.17	3.11
	RPC 17	6.50	1.05	0.26	3.94
	F_1 RPC 17×rye	7.05	1.10	0.18	2.55
Number of spikelets per ear	*Petkus rye*	37.96	4.67	0.93	2.48
	Triumph	18.43	1.67	0.41	2.20
	F_1 Trph.×rye	26.98	4.05	0.45	1.66
	RPC 17	17.17	1.60	0.40	2.32
	F_1 RPC 17×rye	25.05	2.26	0.37	1.47
Number of flowers per spikelet	*Petkus rye*	2.00	0	0	0
	Triumph	5.00	0.74	0.18	3.60
	F_1 Trph.×rye	4.23	0.87	0.09	2.13
	RPC 17	4.92	0.51	0.12	2.43
	F_1 RPC 17×rye	3.40	0.60	0.10	2.93
Length of the spikelet (mm)	*Petkus rye*	15.90	0.91	0.18	1.13
	Triumph	14.55	0.62	0.15	1.06
	F_1 Triumph×rye	18.00	1.63	0.18	1.00
	RPC 17	13.79	0.89	0.22	1.66
	F_1 RPC 17×rye	17.89	1.73	0.28	1.56
Width of the spikelet (mm)	*Petkus rye*	6.59	0.90	0.18	2.74
	Triumph	10.45	1.39	0.34	3.32
	F_1 Trph.×rye	5.73	0.91	0.10	1.73
	RPC 17	9.89	0.90	0.27	2.73
	F_1 RPC 17×rye	5.93	0.80	0.13	2.19

retarded in maturity. The other had grains resembling in type to *T. aestivum* and had tillering of prostatum type. Due to its susceptibility to flying smut it was used in the crossings as standard for measuring the resistance of the hybrids to this infection on one hand and to ensure the possibility of studying the inheritance of resistance, on the other (Fig. 8).

Fig. 8. Triticale form

By performing artificial infection in the experiments we could determine the degree of resistance to yellow rust, thus providing basis for the isolation of rust-resistant hybrid derivates that were submitted to periodical selection with the purpose to maintain these valuable properties.

The simple cross of wheat with *Agropyron* resulted in perennial plants of which in F_2 40 proved absolutely resistant to cryptogamic diseases and yielded twice a year. Another stock made up by 749 plants was picked out with the purpose to provide basic material for fodder-wheat breeding. Desired properties of this fodder wheat included the two annual yields and the ability to survive and yield when planted on eroded, mountainous soils that are otherwise inappropriate for common wheat culture.

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DATA ON THE DAILY RHYTHM OF THE BEHAVIOUR AND CERTAIN LIFE PROCESSES OF CALVES

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Behaviour and daily rhythm of the main vital processes of 6—18-week-old calves were studied by the authors. They established that as a consequence of mutual molestation and shorter recumbency periods, the calves in the pens lay for shorter time. The reasonable cause of this was the mutual influence of the individuals in community. In comparison with the recumbency the time of rumination in a standing position increased, resulting a change in the way of rumination of the pen-kept calves. The time and frequency of hay-eating in pen-accommodation was significantly more than in individual keeping, because the calves imitated each other and learned eating more quickly.

Introduction

Due to the endeavour aimed at concentration and labour saving, large-scale animal husbandry systems have undergone a significant change. At the same time, very few or even no experimental data are available on the behaviour of animals kept under large-scale conditions.

Nowadays the changes in cattle husbandry methods — beginning as early as calf age period — affect each utilization type and therefore in studying cattle behaviour the development of calf behaviour under the conditions of the large-scale calf rearing system employed in this country has been first investigated.

The literature available hardly contains any data on calf behaviour. Within the scope of social behaviour, data have been published only on the mother : calf relation (SCHLOETH 1958) and on the playing tendency of calves (BROWNLEE 1954). In addition, only the pasture behaviour of calves has been observed to render information on their movements, feed intake, resting, rumination frequency and daily rhythm (WEILAND 1965). One of the authors (CZAKÓ 1961) having examined the behaviour problems of farm animals stated that the development of the so-called social sequence could not yet be discovered, among young calves since their interbehaviour, while kept in groups, is based upon the interactions of equals.

Material and Method

Experiments with the primary objective to observe the daily rhythm of certain life processes in calf behaviour have been conducted at the Tengelic Experimental Station. These observations aimed at collecting data on the daily rhythm and intensity of life processes brought about by age and feeding variations.

The observations involved in each case three consecutive days. On the basis of a pretest period we found that the difference between the data measured daily was insignificant, thus the average of three days could be considered as a reliable information on calf behaviour.

The possible extent of substituting continuous data collection for calves with periodical registration was also studied from methodological aspects. According to the literature only the data collected by SCHOLZ *et al.* (1964) on cows can render informations on this problem by claiming that 10 minutes observations compared to continuous procedures show a deviation of 1.16 per cent for the feeding, 0.61 per cent for the resting, and 1.19 per cent for the standup figures. Our experimental results reveal that the period value percentage differences calculated between the continuous and 10 minutes interval observations, respectively, are insignificant. Consequently, with the 10-minute interval data registration the daily rhythm and the intensity of life processes of calves can be reliably characterized.

Table 1 summarizes the behaviour data viz. the principal indices characterizing the life processes of the 6-week-old calves kept in common and in separate pens. The figures of this Table reveal that calves kept in common pens rest for a shorter period of time than those accommodated individually. While the time devoted to fodder consumption and rumination does not show characteristic variations with accommodation differences, the one devoted to hay consumption increases significantly in case of animals kept in common pens. Group accommodation affects also the state of rumination, as rumination in a lying position takes much shorter time than in a standing position when it is increasing to a significant extent. The figures representing lie-down and rumination frequencies show that different accommodation types do not influence resting and rumination period numbers. These data also reveal that the calves lie down in group accommodation as frequently as the ones kept individually but while molesting one another each resting period becomes of a shorter duration. In addition to the total time devoted to hay consumption, group accommodation — compared to the corresponding figures shown by individual accommodation — exhibited for its frequency a higher numerical value.

The observations covered calves kept in individual as well as in common pens.

In group accommodation the changes of principal life processes taken in the function of age have been investigated.

Common pens contained groups of 10 calves each. On the average, group A involved 6-week-old calves, group B 12-week-old, group C 15-week-old and group D 18-week-old animals. Each calf had an area of 1.6 m^2 in the common stall. Feed trough length per calf amounted to 0.30 m, with a corresponding hay grid length of 0.24 m per animal. Thus all calves could simultaneously consume either fodder or hay.

The percentage ratio of the total resting, feeding and rumination time of different age-group calves (6 to 8 weeks) kept in group accommodation is presented in Table 2. These figures show that the calves spent the most of time in each 24 hours and in each age group by resting. Thus the animals devoted about 53 to 70 per cent of the total time per day to be lying and about 17 to 22.5 per cent to be ruminating.

As far as the resting period is concerned, the average value of the 6-week-old (A) group differs only significantly from that of the 12 to 18-week-old (B, C and D groups) animals. The differences between groups B, C, and D, respectively, seem to be negligible. At the same time, a decreasing trend in the percentage of the total resting period proportional to age increase, could be discovered.

As for the rumination, the time of which shows an increasing trend with age, differences between groups did not appear significant, either. A considerable difference can be discovered, however, in the time devoted to feeding between group A and B, C, D, respectively. In group A (6-week-old), calves spent 9.31 per cent of their total time to feeding but this ratio increased to over 22 per cent from the age of 12 weeks onwards. This difference may be attributed, primarily, to the change in feeding. Calves of 6-week-age are fed mainly milk, whereas those of 12 weeks and older have mostly solids as feed, the consumption of which takes much more time (the time spent for milk consumption was not taken into account because it was executed in separate premisses, and highly affected by the labour rendered). The time spent for rumination does not show such great differences between the 6-week-old (A) group and the calves of 12 weeks or older (groups B, C and D), as the time devoted to eating, because the complex gastric system of the calves of a few weeks of age is about to develop exactly around this

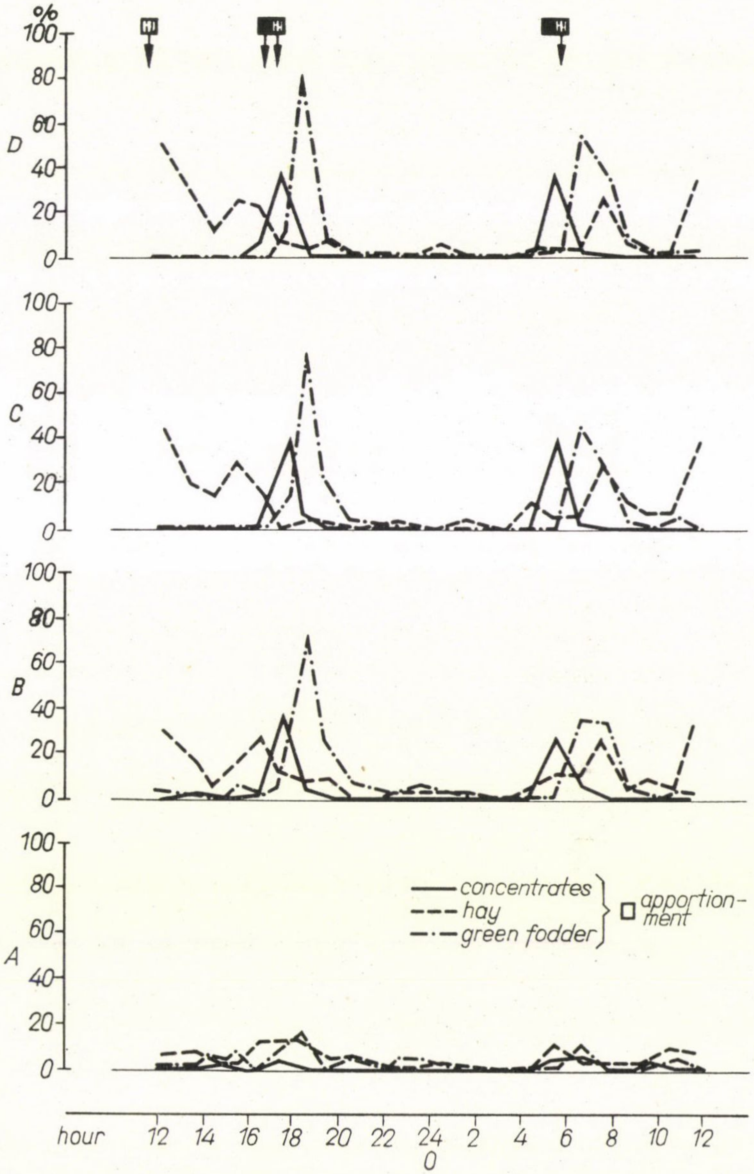

Fig. 1. The eating of concentrates, hay and green fodder

time, and the rumination process is presumably slower than that of older animals then a relatively longer period of time is needed to ruminate the solid feed of even less quantity.

Studying the differences of total resting, rumination and feeding time figures between groups (on basis of t-value) it appears that the differences in total resting time between individual groups are generally significant. Only the difference between groups C and D is negligible. As for rumination or feeding, however, only the differences relating to group A show significant values. Rumination and eating time differences observed between 12, 15 and 18 weeks old calves, respectively, are insignificant.

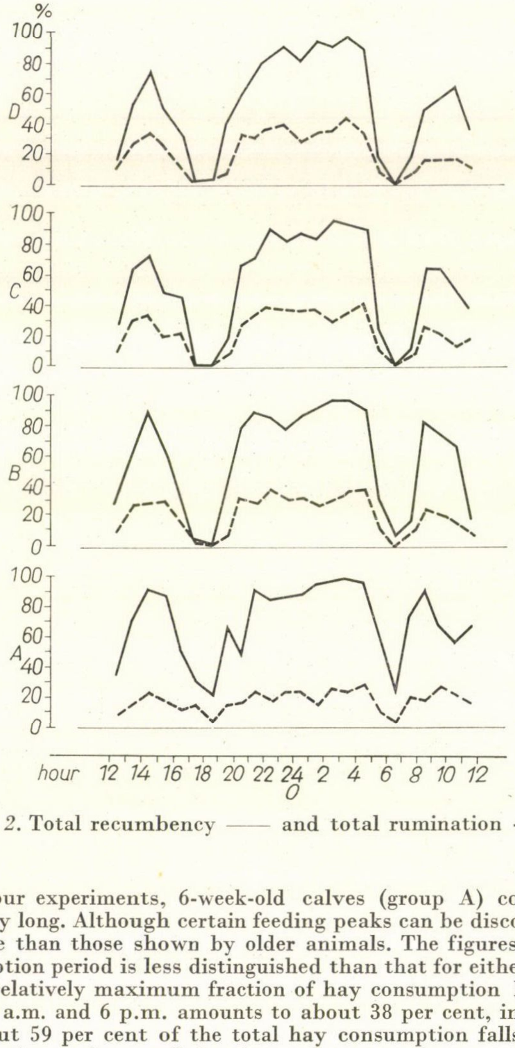

Fig. 2. Total recumbency —— and total rumination ------

According to our experiments, 6-week-old calves (group A) consume the solid feed supplied almost all day long. Although certain feeding peaks can be discovered also here, these are much less definite than those shown by older animals. The figures clearly indicate that the peak hay consumption period is less distinguished than that for either feed or greenforage. While, however, the relatively maximum fraction of hay consumption by 6-week-old (group A) calves between 12 a.m. and 6 p.m. amounts to about 38 per cent, in case of 18-week-old calves (group D) about 59 per cent of the total hay consumption falls on the same period. Hay consumption continues almost all day long: there are always some calves standing in front of the feeder. While there may be such an expressive continuity observed in hay consumption, feed or green forage consumption reveal distinguished morning and afternoon peak periods as early as in the age of 12 weeks (Fig. 1).

Fodder and green forage peak consumption periods narrow with age, by then, more and more animals surround the feeder in the same time. Although the two consumption peaks may be discovered in hay consumption as well, with the exception of group D, these are less clearly defined than the fodder or green forage consumption peaks. Furthermore, this period will be increasingly shifted away towards noon or the after-noon hours with advancing age, that is, towards the time of feeder filled-up. Thus the greatest number of animals consuming hay simultaneously is concentrated to this time — this is when the greatest part of the hay supplied is consumed — in spite of the fact that hay can be found in the feeder all the time.

The daily rhythm and periodicity of rumination is affected by feeding times. With the exception of peak feeding periods, rumination is generally uniform if more or less fluctuating, and takes place mainly during night rest. As illustrated by Figure 2, the rhythm of rumination is interrupted only by the three fodder consumption periods. Otherwise, about 35 to 45 per cent of the calves is continuously ruminating. This daily rhythm hardly changes with the progress of age although at an age of 6 weeks it is less expressive than later. This is due partly to the difference in feeding, and partly to craw development. Fig. 2 reveals that neither the daily rhythm nor the intensity of rumination display decisive changes with age.

The daily rhythm and distribution of resting does not change with age either, if intensity is expressed by means of the percentage of simultaneously resting calves instead of the frequency value figures. The peak resting period falls, of course, on the night hours. However, a great part of calves is similarly resting through the daytime when not eating. Thus, in addition to the peak period during the night hours, each age group tested exhibited an after-noon peak between 2 and 4 p.m., and a morning peak between 8 and 10 a.m. (between 10 and 11 a.m. in group D). In groups B, C and D, rumination rhythm varies together with the daily rhythm of resting. This is much less expressed in group A but its trend can be clearly recognized.

Results

Comparing the behaviour of 60 to 70-day-old calves kept individually with that of identically fed animals of similar age but accommodated in groups we can see that calves in common accommodation rest to a shorter period than if kept individually. At the same time, resting frequency does not reveal significant difference between the two methods. This indicates that, due to their disturbing each other, calves in group accommodation have shorter rest phases. The cause of this phenomenon must be sought for in the mutual activity of the individuals living in the same community, leading to interactions. Activity means in this case the modifying effect of behaviour, which forms or is able to influence the behaviour of a given group through the mutual activity of each individual in that group. This modifying effect is referred to also by the fact that rumination manner would similarly change in group accommodation as rumination in stand-up position would increase to a considerable extent if compared to that exhibited by calves kept individually. The increased hay consumption time and frequency lead to the conclusion that calves kept in groups learn sooner how to eat (imitation).

Table 1

The effect of keeping method on the daily rhythm of calves

Calf kept	In 24 hours 100% time devoted to			Total rumination time, 100%		Total eating time, 100%		Frequency in 24 hours		
	resting	rumination	feeding	lie-down	stand-up	hay	concentrates + silage	resting	rumination	hay eating
Individually ..	70.5	21.2	14.7	99.7	0.3	20.4	55.8	15.6	14.3	3.5
In groups	60.0**	22.0	18.1	94.4*	5.6*	53.1**	45.0	14.5	13.5	14.3**

* Significant at level of probability of 0.05.
** Significant at level of probability of 0.01.

It is belived that, in group accommodation, phenomena modifying certain life processes as compared to those in individual keeping are based upon the interactions of individuals considered "equal" if compared to each other. It may be assumed that upon the effect exerted by the raising method employed, certain changes take place in the morphology of behaviour but not in its physiology. This leads to the conclusion that, from the age of 4 to 6 weeks, there is no need for individual accommodation, and the group accommodation adopted by the practice prevailing in Hungary is both economically practical and suitable from calf behaviour aspects.

The intensity of different life processes characteristic of the behaviour of calves in different age and feeding groups depends partly on age and partly on the feeding methods. Although the effect of age and feeding cannot be estimated by analysis of variance, it is still obvious that the ceasing of milk feeding at 10 weeks of age has an influence on the manifestation of the main life processes studied. Resting period and rumination time percentages primari-

Table 2

Percentage of the total time of resting, rumination and eating in 24 hours on basis of 10 minute observations

Life processes	Groups			
	A	B	C	D
Total resting	69.56	59.05	55.19	53.47
Total rumination	17.15	20.97	22.52	21.18
Total feeding	9.31	22.87	22.29	22.34
Concentrate consumption	0.72	3.08	3.54	3.22
Hay consumption	5.05	10.09	9.93	9.98
Green forage consumption	3.54	9.70	8.82	9.13

Reliability of the differences between groups

	A—B	A—C	A—D	B—C	B—D	C—D
Total resting	***	***	**	*	**	—
Total rumination	**	***	***	—	—	—
Total feeding	***	***	***	—	—	—
Concentrate consumption	***	***	***	—	—	—
Hay consumption	***	***	***	—	—	—
Green forage consumption	***	***	***	—	—	—

* — significant.
** — highly significant.
*** — extremely significant.

ly vary with age, and as far as concentrates, hay and green forage eating are concerned it is the ceasing of milk supply that plays the modifying factor since from 12 to 18 weeks the intensity of these life processes has not changed.

Conclusions

The daily rhythm of life processes is governed primarily by feeding methods and times, although the modifying effect of age can also be observed. The daily rhythm and periodicity are influenced by feeding period development. This will decide the daily rhythm of resting as well. The rhythm of feeding follows feeding practices although the calves might consume hay all day long and the concentrate rations for 6 to 12-week-old calves are not restricted either. The rhythm of solid feed consumption period varies, to a certain extent, with age since peak consumption periods narrow considerably. This refers to the fact that the number of animals simultaneously visiting the feeder will increase.

Thus the experimental data lead to the conclusion that, of all environmental effects it is the feeding technique that represents the factor mostly affecting calf behaviour whereas age and interactions exerted by the individuals to each other are of less importance. Labour system should be, therefore, developed with the peak consumption and resting periods taken into consideration as to promote, above all, undisturbed rumination.

The effect of other environmental components as climatic factors of the stall, juncture of development of social order within groups, etc. on calf behaviour and manifestation of life processes under different housing systems will be studied in further investigations.

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CORRELATION BETWEEN THE AGE AND FERTILIZATION OF RED PEPPER PISTIL

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In the course of experiments the correlation between the age and fertilization of the pistil in red pepper has been studied, pollination being performed at different developmental phases of the bud.

Under the given circumstances the pistil of red pepper maintained its vigour (biotic potential) on the 5th day in each case of the examined variant supposing that pollination had been carried out at the so-called white-bud phase, the result was even better than on the day of emasculating. The optimum fruit-setting and the number of seeds/ fruit developed when pollination was performed on the 3rd day following emasculation. On the 9th day practically no setting occurred in either variant.

The pistil of the examined *K. E-15* variety reached the beginning of sexual maturity when bud was of the size of 3 mm. Depending on the result of daily pollination, from this developmental stage onwards the conceptive ability of the pistil increased. The optimum fertilization was obtained when pollination performed with the pollen gathered on the day of dehiscence of the anther or a day after. In case when no proper (self) pollen was available, we obtained hybrid seed setting at a higher percentage than without emasculating.

Depending on the year, pollination can — on varieties examined — be carried out efficiently for 4—5 days reckoned from emasculation performed in the white-bud phase.

Introduction

On the basis of literary data (COCHRAN 1948, MÁNDY 1946, KORMOS 1948, BALDINI 1952, OBERMAYER—MÁNDY—BENEDEK 1955, ANGELI 1957, SZALVA 1961, DASKALOV—POPOVA 1962, ERDEI—OBERMAYER 1962, POPOVA 1962a, b, MÁRKUS 1963a, b, POPOVA 1963, GAZENBUSH 1964, KHRISTOV—GENCHEV 1965, MUTAFYAN 1965, SOMOS 1966) it can be established that several phases of the flowering biology of red pepper are well known. The examinations have covered also the bearing of time and ways of pollination as well as the developmental stage of the stamen on the most favourable time of pollination taking into consideration the fruit-setting and the average number of seeds. The Hungarian literature of red pepper, however, does not submit such kinds of examinations.

Material and Method

Our examinations were performed on our Kalocsa experimental area in the years 1961, 1962, 1964, 1965 and 1966.

For the examinations the following Hungarian and "exotic" varieties have been used: 1. *Non-hot Kalocsa E-15 (K. E.-15)*, 2. *Non-hot Kalocsa 56-31 (K. 56-31)*, 3. *The hot* *variety of Szeged 48-163 (Sz. 48-163)*, 4. *Sweet pepper of Cece*, 5. *Tomato-shaped pepper*, 6. "*Nigrum*", *hot*, 7. *High, hot cherry-pepper*, 8. *Non-hot clustered cherry-pepper.*

The showing of the experimental material, the growing, planting and nursing of seedlings were performed simultaneously at the usual time and in the usual way in each year of the experiment. According to the demands of experiment the varieties were in plots being of

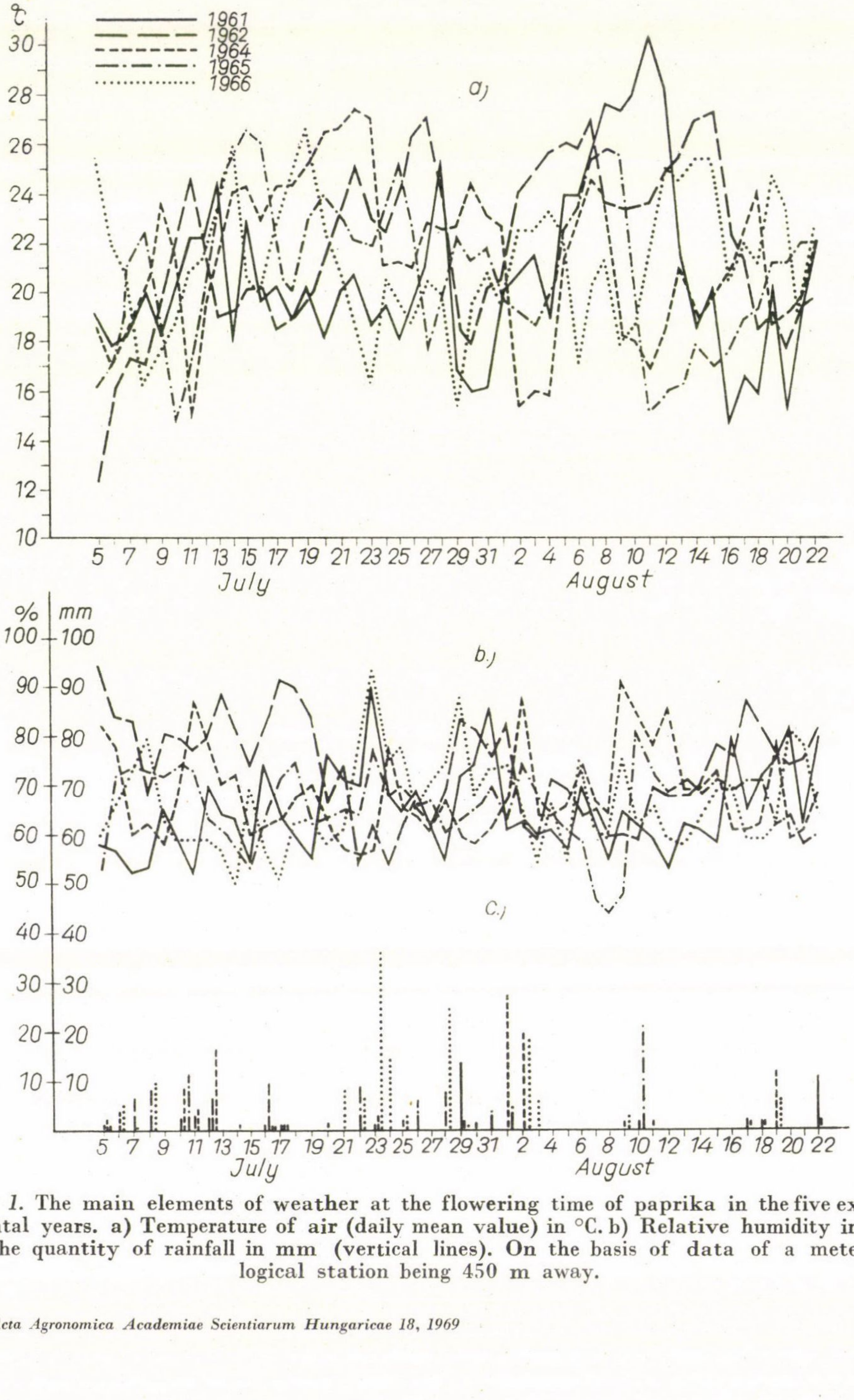

Fig. 1. The main elements of weather at the flowering time of paprika in the five experimental years. a) Temperature of air (daily mean value) in °C. b) Relative humidity in %. c) The quantity of rainfall in mm (vertical lines). On the basis of data of a meteorological station being 450 m away.

different size and next each other, each seedling with a spacing of 60—20 cm. Every year the examinations were made in the main flowering season from 8th July to 20th August. From the marked plants the fruit that had already set, were collected.

According to their character, the examinations might be ranked into three groups. The results are also submitted accordingly.

a) Inter-variety pollination has been performed. The *K. E-15* variety has been pollinated also with the *Szeged 48-163* hot variety. In each variety yearly, at the same time, on the 11th July 1961, on the 19th July 1962, the anthers not yet dehisced were removed from 240 white-budded flowers being nearly of the same developmental stage. After emasculation each flower was isolated with cotton. The pollen required for pollinating was always gathered in the morning hours (up till 6—7 o'clock), and pollination was always performed with fresh, abundant pollen. Pollination was carried out at 30—30 flowers in the case of each variant on the 1st, 2nd, 3rd, 7th and 9th day reckoned from emasculation, — then the flowers were isolated again.

b) The conceptive ability of the pistil was studied on the flowers of *K. E-15* by applying daily the pollen of six different pollinating varieties, throughout 6 days. Previously the flowers had neither been emasculated nor isolated thus there was a chance for both self- and cross-pollination. The time of the first pollination had been determined on the basis of previous observations, about 3—4 days before the dehiscence of the anthers (the bud-size being 3 mm). The examinations took place during the periods 8th July—21st August 1964; 14—26 July 1965 and 18th July—11th August 1966; on 2—3 flowers per plant, altogether 4 × 25 flowers.

c) The method of the examinations differed from that expounded in paragraph b) only in that previous to pollination the flowers had been emasculated. In this case, too, no isolation was applied rendering chance for cross-pollination.

In the course of the examinations the weather was different (Fig. 1). For the year 1961 it is characteristic that at the main flowering time of red pepper, i.e. during the examinations rainfall was extremely little, the temperature of air was proper in July, it was hot in the days of August 7—12; the relative humidity was below the optimum. In the year 1962 the month of July was rainy, both the temperature and humidity were optimum. The month of August was dry, hot temperature with medium humidity. In 1964 rainfall was sufficient; in July the temperature was optimum, while in August it was medium, the relative humidity being optimal. In 1965 rainy, the temperature proper and relative humidity optimal. In the year 1966 the weather was rainy, the temperature was occasionally low while relative humidity high. In the given region i.e. where the examinations have been made, the weather of July 1964 and August 1966 can be considered characteristic, this being in the best agreement with the average of many years.

Results

a) The problem has been approached from the viewpoint occurring in breeding, i.e. how the fruit-setting per cent and the number of seeds change according to days after emasculation performed in the so-called white-bud stage, and what is the final time when the pistil is still capable to get fertilized. In our experiments emasculations and isolations were taken for granted which means that self-pollination and cross-pollination were considered impossible. The results are shown in Table 1.

From the data it can be established that when pollination occurred on the day of emasculation, the percentage of setting i.e. the rate of efficient crossings had been low. The amount of seed-setting became considerably better by the third day and reached the maximum in each variant. On the fifth day only the combination *K. E.-15 × Sz. 48-163* produced good seed-setting (63 per cent). With the other variants the setting decreased, however, the results were generally better than that of pollination performed on the first day. On the seventh day the non-hot varieties *K. E-15* and *K. 56-31* did not produce seed-

Table 1

Seed-setting obtained by pollinating pistils of different age, and the number of seeds per fruit in the years 1961—1962

Combinations	Year	Time of pollination										Average number of seeds of 100 fruit being freely pollinated
		In the phase of white-bud, on the day of emasculating		After emasculation								
				On the 3rd day		On the 5th day		On the 7th day		On the 9th day		
		Seed-setting %	Number of seeds	Seed-setting %	Number of seeds	Seed-setting %	Number of seeds	Seed-setting %	Number of seeds	Seed-setting %	Number of seeds	
K.E-15×K.E-15	1961—1962	33	17	60	43	18	39	0	0	0	0	179
K.E-15×Sz. 48-163		26	68	70	65	63	60	26	19	3	4	—
Sz. 48-163×Sz. 48-163		20	44	48	66	38	63	5	7	0	0	105
K. 56-31×K. 56-31		10	56	66	69	21	45	0	0	0	0	162
Average:		22	46	61	61	35	52	8	6	0.7	1	149

Note: The letters and figures of combinations stand for the abbreviated form of varieties

setting with their own pollen. On the other hand, *K. E-15* produced 26 per cent setting with the pollen of the sharp *Sz. 48-163*. On the ninth day the pistil got fertilized with this variant only, however, the percentage of setting was very low.

The average number of seeds per yield developed nearly according to the values of seed-setting. Most seed was obtained when the pollination had been carried out on the 3rd day following emasculation. If taking into consideration that seed-setting was the most efficient on these two days, it appears that the most successful artificial setting on the pistil could be gained, under the given circumstances, at that time. From the data it becomes also evident that by artificial pollination 24.0—62.8 per cent was obtained as compared to free pollination.

The difference in seed-number appearing between the three varieties, seems to be characteristic of the variety.

The data of Table 1 show that the seed-setting percentage reached its maximum on the 3rd day after which it decreased again. From the 3rd day on, the vigour of the pistil gradually decreased on the 7—9th days.

At the time of the tests the weather was equally dry and warm in both experimental years. We, therefore, submit the data of the two years in a contracted way.

From the data it can be concluded that the pistils of individual plants in the examined varieties maintain their vigour for unequal periods of time. This is clearly demonstrated by the results of pollination performed on the

7th day. The five-day-old emasculated pistil of the variants examined can be pollinated in a dry year.

Emasculating must be carried out on buds at a developmental stage when the petals and anthers are to dehisce in 1—2 days. This is influenced by weather and therefore, a deviation of 1—2 days must be reckoned with. If the weather is dry and warm, the dehiscence of petals and anthers occurs 1—2 days sooner than it would in rainy or cloudy weather. The choice of the proper time of pollination depends on the developmental stage of the anthers since, as a matter of fact, the pistil and the stamen of red pepper become matured at about the same time. Therefore, the emasculation must be carried out before the dehiscence of the anthers. This has to come before the opening of the petals as in most cases it is followed by the dehiscence of the stamina. Occasionally the dehiscence of the anthers may occur before the opening of the petals. No such flowers should be pollinated.

b) We wanted, furthermore, to establish when the sexual maturity of the pistil gets started, and to find out the earliest developmental stage of the bud at which the pistil becomes relatively well fertilized. Therefore by applying, daily, the pollen of six different pollinating varieties, the conception capacity of the pistil was studied throughout a period of six days starting with the bud being of a size of 3 mm. The formation of seed-setting percentage, the number of seeds and the seedless fruit in the different years were examined. The flowers had not been emasculated and isolated, the only interference being the application of the pollen. Besides continuous daily pollination, the conditions of self-pollination and cross-pollination were also at hand. The results are shown in Table 2.

From Table 2 it can be seen that when pollination was carried out — on the first day — at the 3 mm developmental stage of the bud with the Cece variety, hybrids were obtained also in the years 1964 and 1965. On the second day the percentage of hybrids originating from tomato-pepper, increased to a small extent in both years. In 1964 most hybrids (39.08 %) were obtained as a result of pollinations performed on the 4th day with the variety *Sz. 48-163*. The proportion of hybrids coming from the next two pollinating varieties considerably decreased (4.6 and 2.3%, respectively). According to the data of the year 1965, most hybrids (8.29 and 6.79%, respectively) were gained through pollinations made on the third and fourth days. On the 5th and 6th days, similarly to the data of 1965, the proportion of hybrids was reduced (2.09, and 2.91%, respectively). Concerning hybridization percentage, the two years' examinations show diverse results. In 1964, 56.32% of the progenies were hybrids, while in 1965 this was only 22.89%. The majority of the other plants came from pollination with self pollen. The average number of seeds was the most favourable in 1965 (76 per fruit). This is 42.2% of the number of seeds obtained by free pollination in the same year. In the year 1964 the number

Table 2

The effect of pollination of pistils performed consecutively with several parents, at different developmental phases on the examined properties and without emasculating the flowers, in the years 1964—1966

Properties examined	Year	Time of pollination and consecutive pollinating varieties						
		1st day* Cece, sweet	2nd day Tomato-shaped	3rd day** Nigrum, hot	4th day** Sz. 48-163 hot	5th day High cherry-pepper, hot	6th day Clustered cherry-pepper, non-hot	Total matured crop
a) Number of flowers	July 8—August 21, 1964	100	100	100	96	96	88	—
b) Seed-setting per cent		100	100	100	96	96	88	52.00
c) Average no. of seeds		—	—	—	—	—	—	44
d) Per cent of hybridization		1.25	2.30	6.89	39.08	4.60	2.30	56.32
e) Per cent of seedless fruit		—	—	—	—	—	—	7.69
a) Number of flowers	July 14—26, 1965	100	100	98	98	97	94	—
b) Seed-setting per cent		100	100	98	98	97	94	68.00
c) Average no. of seeds		—	—	—	—	—	—	76
d) Per cent of hybridization		0.87	1.94	8.29	6.79	2.09	2.91	22.89
e) Per cent of seedless fruit		—	—	—	—	—	—	2.94
a) Number of flowers	July 18—August 11, 1966	100	96	95	93	93	84	—
b) Seed-setting per cent		100	96	95	93	93	84	57
c) Average no. of seeds		—	—	—	—	—	—	39
e) Per cent of seedless fruit		—	—	—	—	—	—	15.78

* On the occasion of the first pollination the bud-size was 3 mm.

** The dehiscence of the anther reckoned from the first day of pollination ensuing in the year 1964, on the 3rd day, in the year 1965, on the 4th day, in the year 1966, on the 3rd day.

of seeds was 44, while in 1966 this was 39. The number of seeds obtained by free pollination, corresponds to 20.80 and 8.09%, respectively. Seed-settings were the following: in 1964 52%, in 1965 68% and in 1966 57%. The data of the three years show approximately the same value. Of the fruit that had set, 7.69% was seedless in 1964; in 1965 this was 2.94% and in 1966 15.78%.

It can be established that the relatively undeveloped pistil (3 mm bud-size) in the examined *K. E-15* variety is already able to get fertilized. Seed-setting, however, is still very little. In 1964 on the day of dehiscence of the anthers (3rd day) and on subsequent day, the pollen-receiving capacity of the pistil is relatively the highest which reveal itself on the basis of percentage values of hybridization. In 1965 this value is most favourable on the day of dehiscence and the day before. The considerable difference between the values of hybridization may have been due to different weather. In 1965 the artificial pollinations were, in two cases, directly followed by considerable rainfalls. In 1965 the relatively higher number of seeds was the result of self-pollination. The relatively high percentage of seedless fruits in the year 1966 was, most probably, brought about by occasional cold spells and the unusually large amount of rainfall.

c) This examination has been performed with the view to supplement our experiment as described in paragraph b). We wanted to elucidate the problem: what would be the percentage of hybrids coming from different fathers and the rate of all hybrids if the possibility of self-pollination were excluded. The results are shown in Table 3.

From the data of Table 3 it can be seen that in 1964 the pistil got relatively well fertilized as early as on the first day. In 1965 the data gained on the first and second days are similar to those reported on in item b). On the following 3rd, 4th, 5th and 6th days of both years hybrids were obtained at a higher percentage than in the examinations made without emasculation. In the year 1964 the highest value (33.00%) was obtained on the 5th day, while in 1965 this was done so on the 4th day (10.72%). As to the percentage of hybridization, the results of the two years were as well different in the case of this experiment. 87.47% of the progenies were hybrids in 1964 this being about the double of the value we had got without emasculation. In 1965, the rate of hybrids was similarly lower (35.58%), however, by 12.6% higher than without emasculation. On the other hand, seed-setting percentage and the average number of seeds were in all three years proportionally lower than in experiments made without emasculation. In seed-setting the difference was 20% in 1964; 14% in 1965, and 29% in 1966. The number of seeds was less, by 17 in 1964, by 13 in 1965 and by more than the half in 1966. The percentage of seedless fruit became the double in 1964, while in 1966 it increased to more than 3.5 times. In 1965 every fruit contained seed.

From the data it can be established that in case of emasculation, when no self-pollen was available, in 1964 high hybridization could be achieved and in 1965 relatively a higher one than without emasculation. The lower seed-setting values might be attributed to mechanical influences being a consequence of emasculating. The decrease in seed-number appearing consistently in every year, was brought about most probably, by the lack of self-pollen and by the fact that relatively less pollen had got on the pistil. In 1966 a high percentage of seedless fruit was caused partly by mechanical effects, partly by unfavourable weather factors as demonstrated in item b).

Table 3

The effect of pollination of pistils performed consecutively with several parents, at different developmental phases on the examined properties and in case when the flowers had been emasculated, in the years 1964—1966

Properties examined	Year	Time of pollination and consecutive pollinating varieties						
		1st day* Cece, sweet	2nd day Tomato-shaped	3rd day Nigrum, hot	4th day Sz. 48-163 hot	5th day High cherry-pepper, hot	6th day Clustered cherry-pepper, non-hot	Total matured crop
a) Number of flowers	July 8—21, 1964	100	100	96	88	80	72	—
b) Seed-setting per cent		100	100	96	88	80	72	32.00
c) Average no. of seeds		—	—	—	—	—	—	27
d) Per cent of hybridization		8.33	11.11	7.92	16.00	33.00	11.11	87.47
e) Per cent of seedless fruit		—	—	—	—	—	—	18.75
a) Number of flowers	July 16—26, 1965	100	100	95	95	93	93	—
b) Seed-setting per cent		100	100	95	95	93	93	54.00
c) Average no. of seeds		—	—	—	—	—	—	63
d) Per cent of hybridization		1.15	1.21	6.61	10.72	8.07	7.82	35.58
e) Per cent of seedless fruit		—	—	—	—	—	—	—
a) Number of flowers	August 6—11, 1966	100	97	94	88	86	77	—
b) Seed-setting per cent		100	97	94	88	86	77	28.00
c) Average no. of seeds		—	—	—	—	—	—	17
e) Per cent of seedless fruit		—	—	—	—	—	—	57.14

* On the occasion of the first pollination the bud-size was 3 mm.

Conclusions

From the examinations it became evident that, under the given conditions and in case the pollination had been performed at the so-called white-bud stage, the pistil of the red pepper maintained its vigour in every variant thus producing more favourable results than on the day of emasculating. The most seed-setting and the highest number of seed/fruit was obtained when pollination had been performed on the 3rd day following emasculation. On the 7th day in case of 2 combinations the pistil entirely lost its vigour, while in 2 cases the vigour decreased to a great extent. On the 9th day practically no setting was obtained in either variant.

It could be also established that the developmental stages of pistil had a definite influence on the rate of fertilization. The pistil of the examined variety *K. E-15* reached the beginning of sexual maturity when the size of the bud was 3 mm. According to results gained out of daily pollinations, from this developmental stage the conceptive ability of the pistil is increasing. Most hybrids were obtained from pollinations performed on the day of dehiscence or on the day after. The different data of the experimental years might be attributed to diverse weather factors.

When in our experiments no self-pollen was available higher rate of hybridization was achieved than without emasculation. The number of seeds was consistently lower in every year when there was a lack in self-pollen for the pollination.

On the basis of the experiments it can be stated that pollination can be carried out efficiently — on the examined varieties — during 4—5 days reckoned from emasculation performed in the so-called "white-bud" tage.

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SOME PHYTOPATHOLOGICAL RELATIONSHIP AND TOLERANCE TO FRIT FLY OF INDUCED BARLEY MUTANTS

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For several years resistance to mildew and tolerance of loose smut of the summer barley variety *MFB 104* was studied with artificial inoculation and its tolerance of leaf stripe and frit fly with natural infection. Variation amplitude of the totality of mutants in respect of all four features was greater than in the original variety. 0.25 per cent of the mutants is entirely resistant to mildew and suitable as crossing partner. Mutants of the transitory resistance type are not suited for this purpose. The mildew resistant mutant *r 483/7* can be on the strength of its other favourable features also practically valuable. No mutants resistant to loose smut, leaf stripe or frit fly were found. Some mutants can be used as genetic material on account of their tolerance.

Introduction

Experiments to induce mutations have revealed that all features and properties of the barley plant can change by mutation. Among the various types of mutations chlorophyll mutants are most frequent. Detection and selection of the practically important morphological and physiological mutant is more difficult and only successful with appropriate method of selection. For various fungus diseases selection can be carried out already with appropriate provocatory methods with the aid of which not only resistant or tolerant but various physiological mutants can be obtained. In barley up to now literary data have been available mainly on mutants resistant to mildew and loose smut. In our own experiments we have selected the irradiated breeding material of the barley varieties *MFB 104* and *BETA 40* for mildew, loose smut and *Helminthosporium sativum* and on one occasion we have observed differences in the tolerance of frit fly in the mutants.

Freisleben—Lein (1942, 1943) were the first to produce mutants resistant to mildew in the variety *Haisa*. These did not get into general cultivation as, on account of intensive chlorotic spots appearing in advanced age, they were of low productivity. Bandlow (1951) had selected 8 mildew-resistant mutants from the susceptible winter barley variety *Friedrichswerther Berg*. This result was significant because up to that time no mildew resistant cultivated winter barley had been known. Hänsel (1953) and Hänsel—Zakowsky (1956, 1956/1) induced mildew-resistant mutants from the susceptible variety *Vollkorn*. Also the experiments of Hoffmann (1951, 1959), Scholz

(1957), NOVER—BANDLOW (1958), HOFFMANN—NOVER (1959) and others supplied positive results. Recently FAVRET (1960) induced with gamma and quick neutron irradiation from 4 susceptible varieties a total of 20 mutants resistant to mildew. With ethylene oxide treatment on the other hand no such mutants were obtained. In his opinion gamma irradiation was best suited for the production of mildew resistant mutants. As a contrast also experiments with negative results are known. DAVIES—WALL (1958) e.g. found not a single mildew resistant specimen among 18 thousand x_2 plants of the variety *Proctor*. Their data point to the fact that the number of resistant mutants depends beside the methods of treatment and selection also on the starting variety. It is important from the viewpoint of breeding that resistance to mildew is often in correlation with other characters (DORST 1960) so that selection for mildew resistance of the x_2 generation may be useful from other aspects.

Fewer research workers have dealt with the resistance to loose smut of the mutants. PRIADCENCU *et al.* (1960) were the only workers to render account, among others, on "loose smut resistant" mutants induced from the winter barley variety *Cenad 396*. Literary data on resistance to *Helminthosporium* and tolerance of frit fly of the mutants have not been available so far.

Material and Method

Experiments to produce mutations started in 1953 (POLLHAMER 1956) and investigation into the mildew resistance of the selected morphological mutants was reported on for the first time in 1958 (POLLHAMER 1958). Examination of mildew resistance and selection were carried out in two ways. Either the morphological mutants selected in the x_2 generation on the basis of morphological alteration were inoculated with conidium suspension in the x_3 generation or the plants of the x_2 generation were infected without preliminary selection. In the first case a small glasshouse space is sufficient because a comparatively lower number of plants must be inoculated. The mutants selected this way have remained also in later generations resistant to mildew. The mildew resistant mutants non connected with morphological changes, however, cannot be found this way. In the second case a large glasshouse space is necessary but all mildew resistant mutants will be found with a high grade of probability, whether they are connected with morphological changes or not.

Results

Resistance to mildew of 771 mutants of the barley variety *MFB 104* has been examined so far (Fig. 1). From the aspect of breeding the mutants belonging to the evaluation classes *i*, 00 and 0 are interesting, as they represent a resistance of genetically new type as compared with the mildew resistant crossing partners available at present. Apart from these, 30 mutants (3.9 per cent) belonging to the evaluation class "*1*" being slightly susceptible only may be practically also valuable.

Some of the mildew-resistant mutants (e.g. *r 483/7*) are connected only with insignificant morphological changes while others (e.g. *r 644/1*) also morphologically have considerably changed as compared with the original variety. Some mutants represent an interesting type of resistance (Table 1). The field resistance of these is not complete in case of inoculation being found transitory

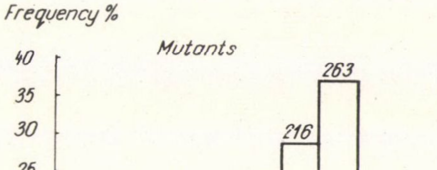

Fig. 1. Distribution of 771 mutants of *MFB 104* and 1037 summer barley varieties according to mildew infection. Martonvásár 1957—65. (The figures inscribed represent the absolute number of members per class)

Table 1

Mutants resistant to mildew of MFB 104
Martonvásár, 1965

Denomination	Convarietas	Varietas	Changed morphological character	Mildew resistant	
				field	glasshouse
r 483/7	*distichum*	*nutans*	thick, strong stem	i + 00	i + 00
r 644/1	*hexast. vulgare*	*hibernum*	four rowed, white ear	i + 00	i + 00
r 287/1	*hexast. vulgare*	*hibernum*	four rowed, white ear	0	0 + 1
r 1114/3	*distichum*	*nutans*	olive green leaf	0	0 + 1
r 2262/6	*distichum*	*nutans*	olive green leaf	0	1 + 2
r 2262/11	*distichum*	*nutans*	olive green leaf	00	2

Table 2

Grain yield of summer barley mutant experiment
Martonvásár, 1964

Ranking	Denomination	q/ha	Rel. % *MFB 104* = 100	± Dev. to *MFB 104*	Score	Mildew res.
1	*MK 52—63*	32.1	130.5	+7.5	I.	00 + i
2	*r 954/3*	30.5	124.0	+5.9	I.	1
3	*r 483/7*	29.8	122.3	+5.2	I.	i + 00
4	Average	26.3	106.9	+1.7	II.	—
5	*r 61/3*	26.2	106.7	+1.6	II.	4
6	*r 243/12*	25.3	102.8	+0.7	II.	4
7	*r 317/4*	25.0	101.6	+0.4	II.	4
8	*MFB 104*	24.6	100.0	—	II.	4
9	*r 292/11*	23.5	95.4	—1.1	II.	4
10	*r 317/5*	23.1	94.0	—1.5	II.	4
11	*r 232/9*	20.3	91.5	—4.3	II.	4
	SD 5%			4.51		

Table 3

Grain yield of summer barley mutant experiment
Martonvásár, 1965

Ranking	Denomination	q/ha	Rel. % *MFB 104* = 100	± Dev. to *MFB 104*	Score	Mildew res.
1	*r 483/7*	43.6	125.9	+9.0	I.	i + 00
2	*r 1114/3*	41.5	119.3	+6.9	I.	0 + 1
3	*r 61/3*	40.8	117.8	+6.2	I.	2
4	*MK 42* stock mixt.	40.5	116.3	+5.9	+II.	i + 00
5	Average	39.1	112.6	+4.5	+II.	
6	*r 2262/6*	38.4	110.6	+3.8	+II.	0 + 1
7	*r 954/3*	38.4	110.6	+3.8	+II.	2
8	*r 17/11*	37.9	109.0	+3.3	+II.	2
9	*r 171/27*	37.5	108.4	+2.9	+II.	2
10	*r 2262/11*	37.1	107.2	+2.5	+II.	00 + 2
11	*MFB 104* 1964	34.6	100.0	—	—	3
	SD 5%			6.06		

(0/1, 0/2) and even susceptible (1/2) plants among them. We have been convinced that these mutants are not good crossing partners as from their hybrids produced with susceptible varieties no resistant plants can be selected.

From practical point of view the mutant marked *r 483/7* seems to be most valuable. This mutant, similarly to the starting variety, belongs to the varietas nutans of the convarietas distichum and its resistance is $i + 00$. Its most important morphological alteration, the thick, coarse and strong stem is favourable both from economical and breeding aspect. As to grain yield, according to the data of the last two years (Tables 2 and 3) it surpassed not only the original variety but also the new mildew resistant selection *MK 42* reported to certification.

With inoculation of the plants of the x_2 generation morphologically unselected so far, partly contradictory data were obtained. While in 1960 0.5 per cent of the plants were resistant at selection (POLLHAMER 1961), in 1964 not a single resistant was found among 23 thousand x_2 plants (POLLHAMER 1964). From the x_2 generation of the winter barley *Beta 40* we had also succeeded in lifting out some resistant plants without preliminary morphological selection, which plants however, became all later susceptible. To a certain extent the production of mildew-resistant winter barley seems to be a more difficult task than breeding a similar summer one.

Artificial loose smut inoculation of the morphological mutants of the variety *MFB 104* was carried out in 1960 (POLLHAMER 1961). With the aid of conidium suspension and injection needle a total of 84 mutants were inoculated. On the plots of plants emerged from infected seed the number of total and infected plants as well as ears was established. The degree of infection of the mutants was characterized by the per cent of plants and ears with smut.

It has been established that there is no perfectly loose smut resistant among the mutants since in each plot more or less infected plants and ears were found. In respect of the loose smut tolerance of the mutants, however, well discernible differences were established (Fig. 2). Loose smut infection of mutants ranged from 10 to 100 per cent. Per cent of frequency calculated on the basis of smut infected plants and ears showed good coincidence. The loose smut tolerance of 10 mutants can be valuable also from the practical point of view since they are less than 20 per cent infected.

In the course of experiments it has been established that in the case of artificial loose smut infection less embryos developed in the flowers of the tolerant varieties and a higher per cent of infected seeds was destroyed at emergence or at the onset of development. Number of plants and ears infected with loose smut indicates first the various degrees of the susceptibility of mutants. Reduced seed set under the influence of infection (in the year of inoculation) and higher destruction in young age (in the year after inoculation) are characteristic of loose smut tolerance.

In our pathological garden the influence of circumstances produced a medium heavy incidence of *Helminthosporium sativum* in 1961. Characteristic symptoms of the disease were found on 0.2 per cent of the plants of the original variety *MFB 104*. Proportion of diseased plants was percentually established on the plots of about thousand plants each of 48 mutants (Fig. 3). The overwhelming part of mutants was weakly infected and in very few cases were more than 10 per cent diseased plants found. Of three mutants not a single plant was diseased. Since this epidemy is of a rare occurrence in Hungary and even in the present case was only of medium intensity the data are considered only as informatory.

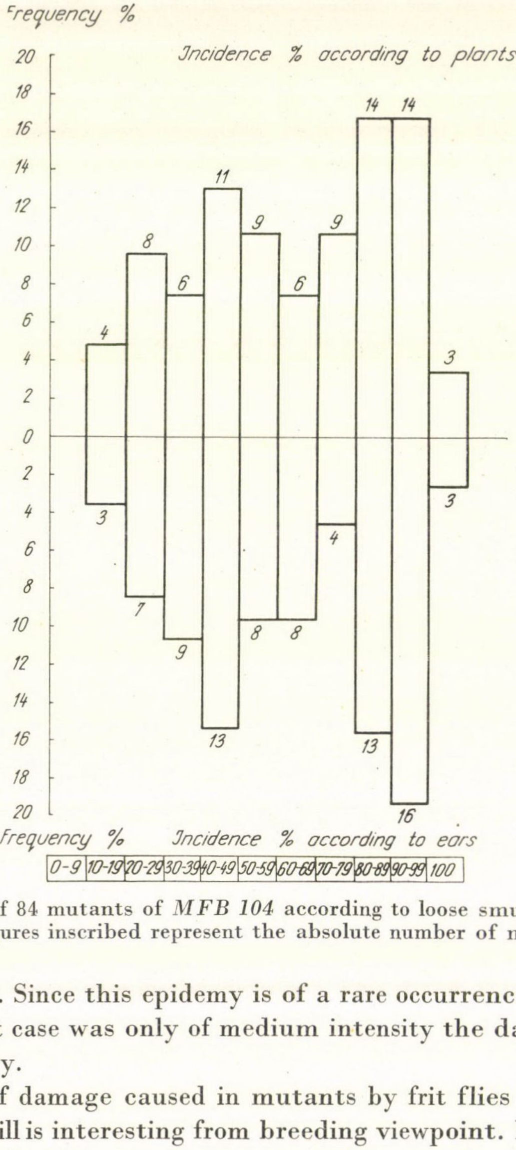

Fig. 2. Distribution of 84 mutants of *MFB 104* according to loose smut incidence. Martonvásár 1959. (The figures inscribed represent the absolute number of members per class)

The degree of damage caused in mutants by frit flies does not concern phytopathology, still is interesting from breeding viewpoint. In 1964, as a consequence of cool soil and heavy damage by mildew the development of barley was slowed down in our pathological garden and a comparatively high number of offshoots developed. This, together with later seeding resulted in a strong frit fly infection on the original variety *MFB 104* and on its 84 mutants.

The intensity of incidence was expressed by having counted all shoots of 10 plants per mutant and established total infection characterized with the percentual ratio of healthy and damaged main- and offshoots (Fig. 4). It has been established that there is no completely resistant among the mutants and it can be more question of a frit fly tolerance of various degree. The majority of mutants are susceptible. The most tolerant mutant *r 232/9* has exhibited a total incidence of 25 per cent, while the most susceptible mutant *r 1756/1* has that of 65.3 per cent (Table 4). In most mutants first the offshoots were damaged and in some the main shoots even remained completely healthy. Examination of the mutants was conducted from May 30 to June 7. The total incidence values of the variety *MFB 104* established May 30 and June 9 and at the same date the per cent of larvae and pupae demonstrate that examinations were conducted in the main damaging period. This was also visually perceptible because owing to the damage the growth of barley almost completely discontinued for a time. It was remarkable that the most tolerant mutants had developed comparatively more main- and less offshoots. In the mutants of more rapid development and less tillering the pests found less plants suitable to be invaded. According to data the conception is quite erroneous that damage by frit fly could be reduced by the breeding of a readily tillering variety. The mutants of rapid development developing comparatively less

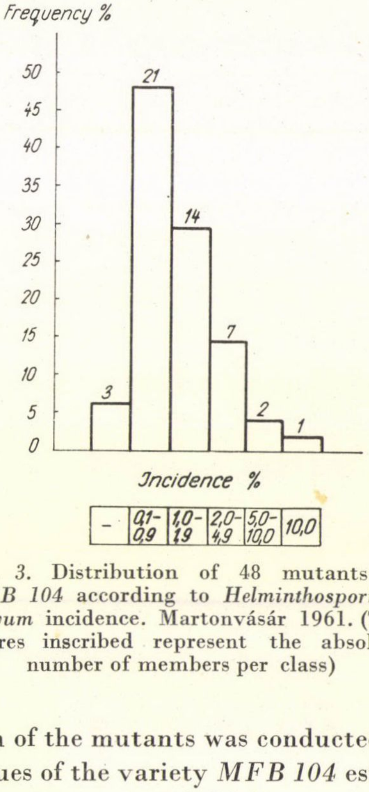

Fig. 3. Distribution of 48 mutants of *MFB 104* according to *Helminthosporium sativum* incidence. Martonvásár 1961. (The figures inscribed represent the absolute number of members per class)

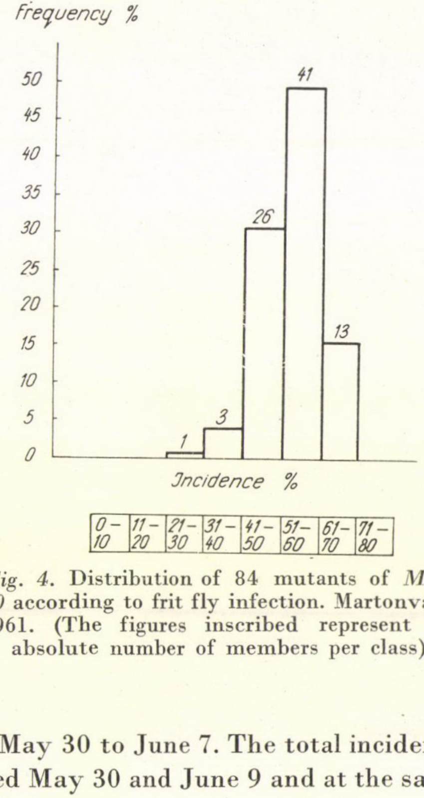

Fig. 4. Distribution of 84 mutants of *MFB 10* according to frit fly infection. Martonvásár 1961. (The figures inscribed represent the absolute number of members per class)

Table 4

Developments of frit fly damages
Martonvásár, 1964

Denomination		Number of plant units	Number of shoot units	Damaged main shoot %	Damaged off shoot %	Total incidence %	Number of larvae %	Number of pupae %
Mutants	VI. 1.	840	7856	1.40	51.10	52.10	—	—
MFB 104	V. 30.	21	216	2.24	46.35	48.59	92.24	7.76
MFB 104	VI. 9.	11	101	3.92	64.38	68.30	44.04	55.96
Most tolerant mutant *r 232/9*		10	72	—	25.00	25.00	—	—
Most susceptible mutant *r 1756/1*		10	78	—	65.30	65.30	—	—

shoots but of the same order can serve as a valuable starting material in breeding a variety tolerant of frit fly.

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THE PARTHENOCARPIC FRUIT SET OF THE "PÁNDY" SOUR CHERRY INDUCED BY TREATMENTS WITH GIBBERELLIC ACID, AUXIN AND CCC

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Combined sprayings of the self-incompatible *Pándy sour cherry* with 2.4-D and gibberellic acid (GA) have yielded parthenocarpic fruits a certain proportion (20 to 23 per cent) of which is satisfactory even from the aspect of rentability. On the other hand, the effectiveness of 2.4-D alone applied is weak and the gibberellic acid sprayed in the same way has proved practically to be ineffective. Indoleacetic acid has hastened the abscission of flowers and fruit rudiments, whether the chemical is used alone or together with gibberellic acid. CCC [2 chloroethyl-(trimethylammonium) chloride] has showed an indifferent behaviour in all combinations. Though *Pándy sour cherry* is self-incompatible, emasculation has diminished considerably the percentage of fruit set in comparison to treatments, when only isolation is applied. Due to the high price of gibberellic acid the results of the experiments are merely of theoretical importance. Besides, it must be underlined that the size of parthenocarpic fruits does not reach that of fruits produced by fertilization either, though a notable part of the former have economical value.

Introduction

Due to its self-incompatibility, *Pándy sour cherry*, one of the most valuable varieties of the species, does not become productive in pure stands, but may produce a satisfactory yield, if planted together with contemporaneously flowering, well fertilizing sweet and sour cherry varieties (Maliga 1954). It is not yet known precisely so far, which are the best pollinating partners, and however much promising the pertaining experiments are, a perfect solution cannot be expected from the most excellent pollinating partner either. Out of the inhibiting factors the following should be mentioned.

If during the period of flowering rainy, windy, cold weather prevails, the action of insects is suspended, and therefore *Pándy sour cherry* does not become productive either in the presence of pollinating varieties.

The extremely altering weather of the Carpathian Basin causes shifts in the phenophases, and so it may occur that in some years the flowering periods of simultaneously flowering partners are shifted so much that no fertilization can take place.

Ultimately the cytological abnormities of the *Pándy sour cherry* must also be mentioned. Murawski—Endlich (1962) observed the development of microspores in many pollen mother cells as a consequence of which aneuploid microspores came into being. From this phenomenon — confirmed also by some factual examinations of the above-mentioned authors (MURAWSKI—ENDLICH 1962) — it may be concluded that in the course of macrospore development similar irregularities occur, which inhibit, in extreme cases, fertilization or if the flowers become fertilized, in the development of the embryo subsequent disturbances may arise, leading to abortus and fruit abscission. In other words: it seems probable that, due to the abnormities of the female sexual organ, from a considerable proportion of the *Pándy sour cherry* flowers no seed and fruit, respectively, can develop, even if the best pollinating varieties and the most favourable pollination conditions are present.

These difficulties suggested the experiments, to promote independently from the sexual processes, the fruit set of the *Pándy sour cherry*, with chemical treatments, by inducing parthenocarpy.

Some experiments of this feature had also been conducted earlier. The chemical "Dikonirt" containing 2.4-D (dichlorophenoxyacetic acid) and suggested by G. FEHÉRVÁRY, had increased notably the fruit set percentage of the *Pándy sour cherry*, but the weight of the parthenocarpic fruits lagged far behind that of the fruits developed after cross-pollination (RADNÓCZI 1961).

Material and Method

1. *Effect of gibberellic acid and indoleacetic acid on the fruit set.* About the beginning of the sixtieth more and more papers reported on the extraordinary effectiveness of gibberellic acid manifesting itself in the induction of parthenocarpy in different fruit species (WEAVER—McCUNE 1959, CRANE—CAMPBELL 1959, CRANE *et al.* 1960, DAVISON 1960, MODLIBOWSKA 1961), so the solution of problem was in the first line expected from this chemical.

The experiments were started on the 25th April of 1962. Compared with the season, in this period the weather was very warm, day-time temperature rose up to 25 to 28° C.

The flowers were treated — immediately prior to their opening, in the state of white budding — with gibberellic acid, indoleacetic acid, with the mixture of both chemicals; for the control tap water was used. After removing the opened flowers the branches bearing flower buds were merged into the solutions for five minutes, and subsequently the treated branch parts isolated with parchment bags. For the treatments 6- to 8-year-old trees had been chosen. As due to the unusual warm weather the flowers had opened unexpectedly soon, only few flower buds, altering in number per tree, were found.

2. *Effect of gibberellic acid and 2.4-D on the fruit set.* Further investigations of the author were usefully promoted by the work of REBEIZ—CRANE (1961), who had succeeded in provoking economically satisfactory parthenocarpy in the "Bing" cherry variety by the combined application of gibberellic acid and 2.4-dichlorophenoxyacetyl-methionine. Considering the close relation of sweet and sour cherry, the spraying with those chemicals promised good success also in increasing the fruit set of the Pándy sour cherry.

As 2.4-dichlorophenoxyacetyl-methionine was not available, in the experiments — following the advice of the above American authors (REBEIZ and CRANE, unpublished) — 2.4-D has been used, which, in combination with gibberellic acid, is also effective.

Expecting already an economically useful success, the experimental sprayings have been carried out on larger scale in the three-year-old spindle-bush *Pándy sour cherry* orchard of the Fertőd Experimental Farm.

To achieve better fertilization, the *Pándy sour cherry* was planted in alternating rows with "Germersdorfer" sweet cherry. The initial weak development of the latter and, consequently, its sparse flower quantity, however, resulted in so weak fertilization that it was not worth while to pick the sporadically appearing fruits.

The spraying was carried out with knapsack sprayers of the "Harmat" type (produced in Csepel) on April 29, 1964 during the period of full flowering. For the treatments different

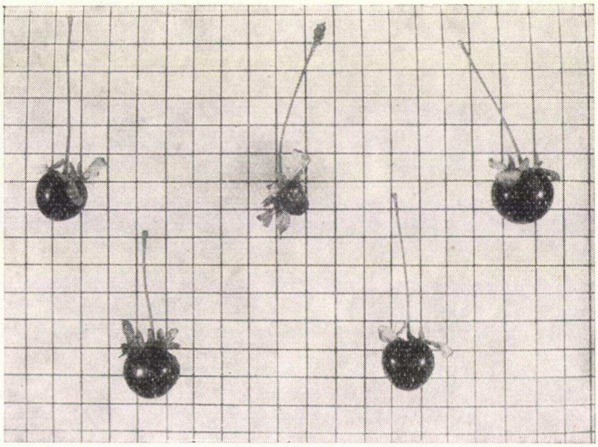

Fig. 1. Economically valuable and valueless (in the middle) parthenocarpic fruits developed under the influence of combined spraying with gibberellic acid and 2.4-D

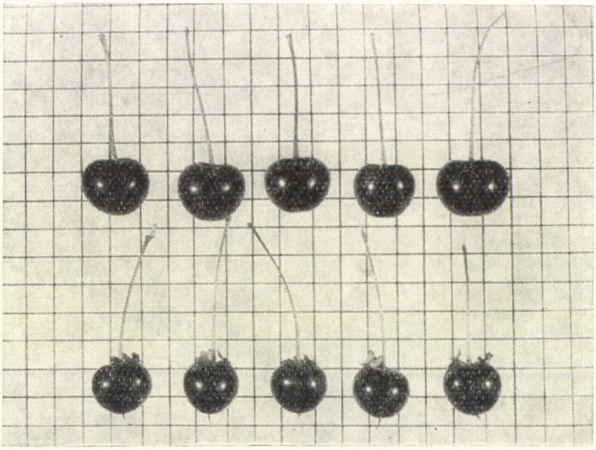

Fig. 2. Above: Fruits produced by cross-pollination. Below: Parthenocarpic fruits induced by combined spraying with gibberellic acid and 2.4-D

concentrations of gibberellic acid and 2.4-D as well as the mixture of both chemicals were used (Table 2). As in the course of preliminary experiments gibberellic acid in itself had not proved effective, this chemical was applied only together with 2.4-D. In each treatment 5 trees standing isolated in the area were sprayed.

In the valuation performed during the period of fruit picking naturally nothing but the parthenocarpic, economically valuable fruits were taken into consideration (Fig. 1). The remnants of sepals and styles may be detected on the parthenocarpic fruits even in their fully ripe state (Fig. 2), therefore the fruits developed under the influence of the treatment can rather surely be separated from those produced after fertilization. In dubious cases the size of the endocarp (Fig. 3), the presence or absence of seeds (Fig. 4) offered possibilities for the separation. To diminish the failures resulting from the different thickness of trees, fruit quantities were related to the diameter unit (1 cm) of the stems.

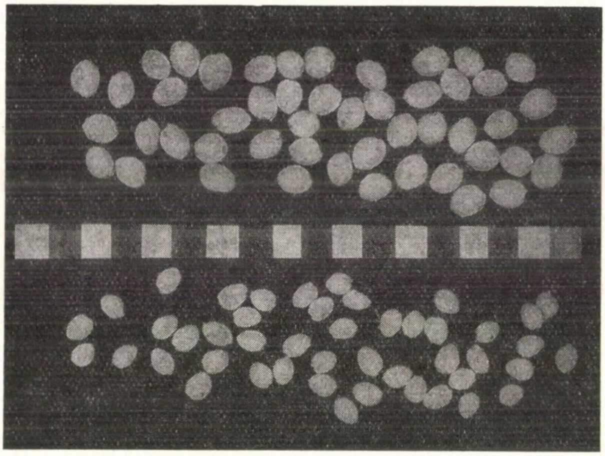

Fig. 3. Above: Seeds of fruits produced by cross-pollination. Below: The "seeds" of parthenocarpic fruits induced by combined spraying with gibberellic acid and 2.4-D

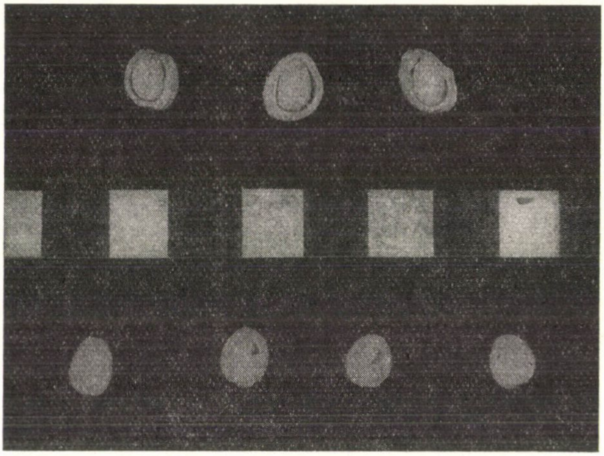

Fig. 4. Above: Viable seeds of fruits produced by cross-pollination. Below: Parthenocarpic fruits contain only seedless endocarp

3. *Effect of CCC on fruit set.* It is known that between the growth vigour of fruit tree and the formation of their flower-buds a negative correlation exists. Sprayings with gibberellic acid stimulate the shoot growth of most plant species, and retard, consequently, the formation of flower-buds. This effect has also been observed on *Pándy sour cherry* trees (Figs 7 and 8). The harmful effect of gibberellic acid manifesting itself in the inhibition of flower formation had to be counterbalanced by the growth retarding chemical CCC [2-chloroethyl-(trimethyl-ammonium)-chloride]. As in the experiments of BUKOVAC (1962) CCC uptaken from the soil decreased considerably the shoot growth of the *Montmorency sweet cherry*, a similar result has been expected from this treatment if applied to sour cherry. Besides, it should still be found out, whether CCC combined with gibberellic acid and 2.4-D in the period of flowering decreases as "antigibberellin", the percentage of parthenocarpic fruit set or not We have secretly hoped that CCC may eventually promote also the parthenocarpic fruit set, because in the latest literature (COOMBE 1965) data on such properties of CCC have been published.

Fig. 5. Pándy sour cherry sprayed with a combination of gibberellic acid (200 ppm) and 2.4-D (50 ppm) in the period of full flowering yielded economically valuable fruits

Fig. 6. On untreated trees only few fruits produced by cross-pollination developed

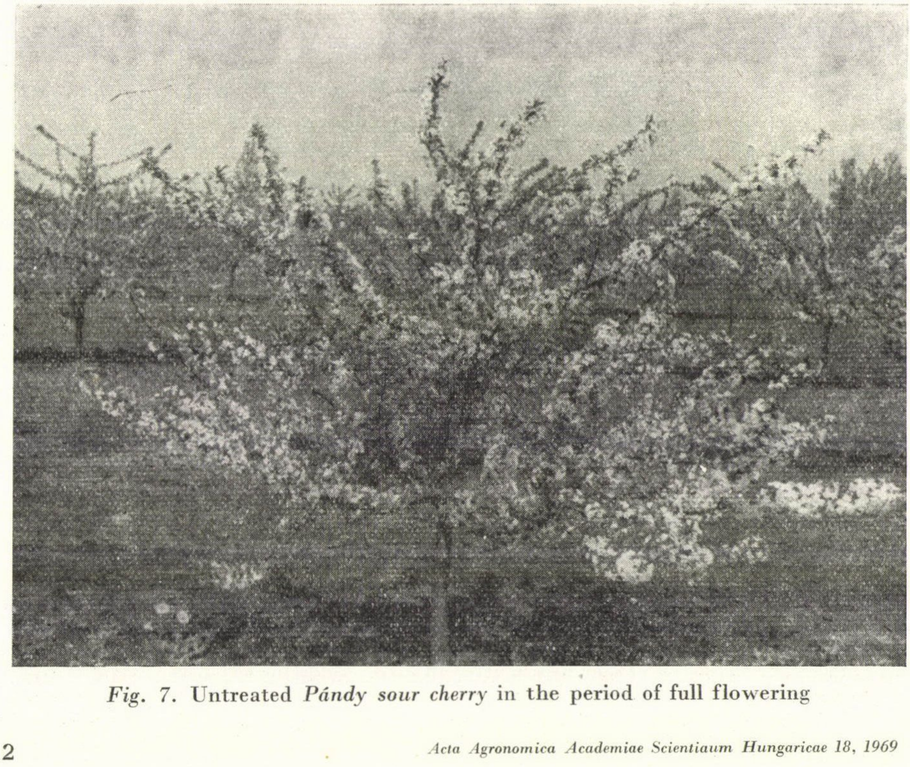

Fig. 7. Untreated *Pándy sour cherry* in the period of full flowering

Fig. 8. Full flowering of *Pándy sour cherry* sprayed in the preceding year with a combination of gibberellic acid (1000 ppm) and 2.4-D (100 ppm)

The spraying was carried out in the four-year-old spindle-bush *Pándy sour cherry* orchard of the Fertőd Experimental Farm on the 4th May of 1965. The method of treatments corresponded to that in 1964. For each treatment 5 trees not sprayed in the previous experiments were chosen, on each of them 200 flowers were held under observation, but only the economically valuable parthenocarpic fruits were registered. Unfortunately, due to damages done by birds, the data of valuation performed in the period of full ripeness were somewhat distorted and therefore in Table 3 the results of an earlier fruit counting (7. VI) are presented.

4. *Parthenocarpic fruit set after combined application of castration and isolation.* The valuation of sprayings performed under natural conditions without isolation did not cause difficulties, because parthenocarpic fruits differed morphologically from those produced by cross-pollination and appeared otherwise sporadically only. However, it was considered as necessary to make certain of the reality of parthenocarpy under controlled conditions.

As it is known, in some cases the embryos abort very early after normal fertilization, but despite this fruits do not drop, because this initial stimulation suffices for their development. Such fruits, containing not viable seeds, cannot be differentiated from really parthenocarpic ones, though in this case we have to deal with pseudo-parthenocarpy.

It could be assumed that also in the experiments reported here, beside the applied chemicals the stimulating effect of cross- or self-pollination had promoted the development of parthenocarpic fruits as well.

To prove the reality of parthenocarpy, flowers in the state of white budding of *Pándy sour cherry* were isolated, castrated and subsequently isolated in April 1966. As experimental specimens five-year-old spindle-bush trees were used. In each treatment 2000 flowers divided on four trees were isolated and 400 flowers divided on two trees castrated. The treatments were carried out with a brush on the 19th of April, 7 or 8 days after isolation and castration, when the greatest part of the flowers had already been open. Such chemicals and their combinations had been chosen, the effect of which permitted to form a more or less true notion on the basis of previous experiments.

Results

1. *Effect of gibberellic acid and indoleacetic acid on the fruit set.* The data of valuation performed at three dates are summarized in Table 1.

First, under the influence of gibberellic acid, fruits began to develop but later all of them dropped still before ripening. Indoleacetic acid rather caused the abscission of fruits and flowers respectively, and impoverished also the weak effectiveness of gibberellic acid, if applied together with the latter. It is worth mentioning, however, that the peduncles from which the opened flowers had been cut off before soaking, survived for the most part in all treatments containing also indoleacetic acid, whereas from branches soaked into pure gibberellic acid or tap water, all peduncles dropped. So in both examined phenomena the effect of indoleacetic acid dominated, when a mixture of indoleacetic acid and gibberellic acid was used.

Table 1

Effect of gibberellic acid and indoleacetic acid on the fruit set of isolated Pándy sour cherry

Treatment		Flower buds treated	Fruit set					
			May 13		May 27		June 27	
Chemicals	Concentration (ppm)	pieces	pieces	%	pieces	%	pieces	%
Tap water ...	—	90	18	20.0	0	0.0	0	0.0
GA*	100	119	60	50.4	12	10.1	0	0.0
IAA**	100	60	1	1.7	0	0.0	0	0.0
GA + IAA ..	100 + 100	119	2	1.7	1	0.8	0	0.0

* GA = gibberellic acid.
** IAA = indoleacetic acid.

In other words: the experiment had practically no success, neither gibberellic acid nor indoleacetic acid proved to be a suitable tool for inducing parthenocarpy.

2. *Effect of gibberellic acid and 2.4-D on fruit set.* Sprayings yielded surprisingly good results (Figs 5 and 6). GA and 2.4-D acted synergistically also in inducing parthenocarpy in sour cherry. From the data of Table 2 it is evident that especially those combined treatments of GA + 2.4-D were effective, in which the concentration of gibberellic acid amounted to at least 100 ppm and that of 2.4-D to at least 50 ppm. Therefore, the concentration of both chemical should be, to the necessary minimum, parallelly increased.

The average weight of economically valuable parthenocarpic fruits was 3.2 g, whereas those produced by cross-pollination in the control trees weighed averagely 6.2 g. For the moment it cannot be found out precisely, whether

Table 2

Effect of combined spraying with gibberellic acid and 2.4-D on the parthenocarpic fruit set of Pándy sour cherry

Treatment		Fruits per tree-trunk diameter (cm)
Chemicals	Concentration (ppm)	
—	—	—
—	—	0.00
GA + 2.4-D	50 + 25	0.94
GA + 2.4-D	100 + 25	1.02
2.4-D	25	1.09
GA + 2.4-D	50 + 50	1.49
GA + 2.4-D	200 + 25	1.56
2.4-D	50	6.58
GA + 2.4-D	100 + 50	16.68
GA + 2.4-D	200 + 50	25.68
$SzD_{5\%}$*	—	11.07

* $SzD_{5\%}$ = Significance at the 5% probability level.

the weight decrease is connected with parthenocarpy or we have merely to deal with a competitive sharing of nutrients by fruits appearing on sprayed trees undoubtedly in greater amount. This effect is probably still increased by the numerous very small parthenocarpic fruits not figuring in the tables. These fruits do not drop before ripening as it happens in case of the control trees, and are, therefore, a burden for the fruit trees without any economical benefit.

With the best combined treatment the induced parthenocarpy has increased fruit yield only by 520 g in the average per tree; but considering the age of the trees, this quantity is already worth mentioning.

3. *Effect of CCC on the fruit set.* Trees treated merely with CCC have not yielded parthenocarpic fruits, similarly to the controls. CCC applied in combination with gibberellic acid and 2.4-D has decreased the percentage of parthenocarpic fruit set, but the difference is not significant (Table 3).

Accordingly, it turns out from the foregoing data that CCC sprayings applied in the period of full flowering cannot affect the parthenocarpic fruit set either favourably or harmfully. It still remains to investigate, whether CCC really counterbalances the stimulative effect of gibberellic acid on shoot growth or not. These examinations, however, transgress the bounds of the present paper.

4. *Parthenocarpic fruit set after the combined application of castration and isolation.* Results are similar to those obtained in treatments without isolation (Table 4). Gibberellic acid stimulated fruit development only at the beginning,

Table 3

Effect of gibberellic acid, 2.4-D and CCC on parthenocarpic fruit set

Treatment		Flowers treated, pieces	Fruit set %
Chemicals	Concentration (ppm)		
—	—	1000	0.0
CCC	500	1000	0.0
CCC	1000	1000	0.0
CCC	2000	1000	0.0
GA + 2.4-D	500 + 50	1000	23.7
GA + 2.4-D + CCC	500 + 50 + 500	1000	15.3

later all fruits dropped. 2.4-D alone has only a weak effect, but the combination of both chemicals led to satisfactory results again. In contradistinction to previous experiments performed without isolation between the treatments consisting of GA 200 + 2.4-D 25 and GA 200 + 2.4-D 50 no significant differences were found. This may probably be explained by the fact that in this experiment brushes were used instead of knapsack sprayers, so a greater quantity of the agent could be brought on the flowers and the critical amount of 2.4-D was achieved in lower concentration.

Castration decreased the percentage of fruit set considerably in comparison of the results achieved by applying only isolation, and proved to be more or less successful merely by combining gibberellic acid and 2.4-D (Table 5). For the moment it is hard to say, whether the diminished percentage of fruit set should be attributed to the castration-caused wounding or perhaps to a lack in the stimulative effect of the otherwise self-incompatible pollen.

Independently from this, the data reveal that using chemicals parthenocarpic fruits can also be obtained by excluding cross- or self-pollination.

Table 4

Effect of gibberellic acid and 2.4-D on parthenocarpic fruit set after isolation

Treatment		Flowers treated, pieces	Fruit set			
			May 6		June 1	
Chemicals	Concentration (ppm)		pieces	%	pieces	%
—	—	2185	4	0.2	0	0.0
2.4-D	25	2025	139	6.9	19	0.9
GA	200	2252	154	6.8	0	0.0
GA + 2.4-D	200 + 25	2200	401	18.2	121	5.5
GA + 2.4-D	200 + 50	2215	422	19.1	186	8.4

Table 5

The effect of gibberellic acid and 2.4-D on parthenocarpic fruit set after the combined application of castration and isolation

Treatment		Flowers treated, pieces	Fruit set			
			May 6		June 1	
Chemicals	Concentration (ppm)		pieces	%	pieces	%
—	—	421	2	0.5	0	0.0
2.4-D	25	433	4	0.9	0	0.0
GA	200	417	6	1.4	0	0.0
GA + 2.4-D ..	200 + 25	417	101	24.2	15	3.6

Conclusions

Due to the high price of gibberellic acid the experimental results reported here are merely of theoretical significance. Besides, it should be remarked that the size of parthenocarpic fruits does not reach that of the fruits produced by fertilization, though a considerable part of the former is of economical value.

As it was previously mentioned, in the decrease of fruit size also the effectiveness of treatments may play an important role. Effective spraying combinations may obviously increase fruit quantity per tree to a high degree, while in the amount of substances produced and uptaken by the tree practically no changes occur, which causes an inevitable reduction of fruit size.

Sprayings were performed in the period of full flowering being most sensitive for fruit set, accordingly the results achieved are very good, and, due to the fruit set percentage higher than expected, excessively favourable. It may be assumed that by changing the time of spraying according to the phenophase of flowering, the quantity and consequently the size of fruits can be regulated.

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TRACE ELEMENT SUPPLEMENTATION OF PASTURES

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Effects of trace element supplementation on yield and mineral composition of plants have been studied. It has been established that in Hungarian conditions trace element supplementation alone can raise yields on pastures although within moderate limits. Concerning feeding value, mineral composition of second mowing was faintly altered only. Fertilizing of N and NPK types increased with 27 per cent copper deposition in plants. Authors suggest that zinc-enriching and manganese decreasing effect of boron must be ranged into recorded synergisms and antagonisms of ions.

Introduction

Trace element supplementation of pastures is practised to obtain qualitative and quantitative profits in yield. Sometimes the increasing of vegetal trace element contents to prevent livestock disorders is the unique purpose. Others aim to reach higher yields or to influence organic composition favourably by optimal satisfaction of trace element requirements. Independently from the purposes, trace element manipulations — intended or involuntarily — affect the harmony of metabolism of plants.

It seems to be pertinent to widen knowledges about these vegetal metabolic changes in order to prevent unfavourable results, which have been already reported by several authors concerning soil trace element supplementation.

Microelement treating of pastures has been infrequently studied in Hungary. Tóth (1961), Tóth—Szabó (1959) have made supplementation experiments with certain microelements on moor soils in environment of Keszthely. Concerning microelement fertilization of culture-plants Kuthy *et al.* (1963), Győri—Fekete (1963), Di Gleria (1962), Keresztény (1961), Frenyó—Márton (1958), etc. have carried out investigations.

In other countries, microelement completions of pastures have aimed partly to raise the concentration of certain element from sanitary consideration Rademacher (1935), Rossiter *et al.* (1948), Andrews (1953), Muller (1964), etc. partly to consolidate or eventually increase yearly yields (Gruhn *et al.* 1952, Kleinig—Loveday 1962, Smeltzer *et al.* 1962, Kac-Kacas *et al.* 1964).

Sometimes, apparently contradictory observations have been also reported, deriving from eventual incomparability of different experimental conditions.

One of us (HARASZTI 1961) has carried out field trials in order to observe the effects of complex fertilizer treating on pastures. Hay samples harvested have been analysed chemically by TÖLGYESI (1961). In this way, we can contribute data equally on effects of micro element fertilizers on yield (I) and mineral composition of plants (II).

Material and Methods

Experiments were carried out on the pasture parcel of the State Farm Komárom, district Szőkepuszta, in 1964. Grass was original, not settled, on muddy soil of field character, whose structure was loose, dark-grey coloured. Superficial layer showed uniformly humus character, subsolum polyaedric to 20—50 cm depth.

Its hydrogen exponent proved to be pH 8.2 in water, it contained 13.1 per cent of humus, soluble phosphorus 3.3 mg per 100 g, 71 abs. per cent, and soluble potassium 13.5 mg per 100 g, 50 abs. per cent.

Microelements in the soil, according to chemical analysis:

Microelements	Mn	Zn	Cu	Mo
	ppm			
Total quantity	890	75	11.7	2.84
Mobile form of total (according to *Pejve*)	89	8	11.3	0.14

The above data showed no deficiency in elements analysed. Neither did the vegetation, and its mineral composition approached well the average of the country.

The coenosis could be characterized as *Agrostion albae–Alopecureto–Festucetum pseudovinae* species.

In the last twenty years the experimental grass has neither been manured nor fertilized and has always been used as pasture for cattle. The precipitation of growing season in the

Group mass values and their changes:

Groups of coenosis	Untreated (control)	Fertilized by NPK + micro elements	
	I. mow %	I.	II.
		mow %	
Gramineae	42.46	48.62	42.53
Cyperaceae-Juncaceae	10.86	21.68	22.93
Papilionaceae	7.18	7.56	9.28
Miscellaneous (weeds)	39.50	30.89	26.51

experimental year, 1964, was 305 mm, less than the geographic average (346 mm), but fallen in favourable mensual distribution.

The experiments were settled on parcels of 57 qm area, each experiment in four identic and random arrangement. With traditional fertilizers five treatments were made. In the first series, only microelements were given, without ground manure. In the second, "linzer salt" of 25 per cent nitrogen content was given, 400 kg per kh (kh = katasztrális hold = Hungarian unit of area, 1 kh = 0.57 hectar = 1.41 acres). In the third series from "superphosphate" of 17 per cent phosphorus content 150 kg per kh, in the fourth series potassium salt (40 per cent conc.) 80 kg per kh were given. In the fifth series Nitrogen—Phosphorus—Potassium (further NPK) combination were given, each components corresponding to the above quantities. In the sixth series, urea fertilizer of 46 per cent nitrogen content was sprayed over the parcel, as ground manure. Each five series of ground fertilizers were completed with identic quantity of B, Mo, Mn, Co, Cu, Fe and J micro elements and Mg oligo element, and each series according to the requirement of random arrangement had its corresponding control parcel. Thus, one block contained 54 alternatives of five ground fertilizers combined with microelements, microelements alone and controls. According to the studies of GYŐRI (1963), trace element content of common fertilizers is practically identical to that of soil, therefore negligible.

Doses and forms of microelements:

Form	Quantity, kg/kh	
	as salt	as element
Borax	4.2	0.44
Ammonium molybdate	8.4	4.6
Manganese sulphate	8.3	1.7
Cobalt chloride	3.3	0.82
Copper sulphate	25.0	6.3
Magnesium sulphate	83.0	8.2
Ferric sulphate	33.0	6.6
Potassium iodide	2.8	2.1

Ground fertilizers and Cu, Mg and Fe salts were spread in spring (13th March) as direct plant manure, and other salts of microelements were applied dissolved in 30 l water, as irrigation from watering-can.

Judgement of experiments. The effects of fertilizers on the promotion and state of certain grass constituent species were tested in 2—3 weeks, during one growing season. Yield was measured twice by mowing with hand, 3rd of June and 7th of July. Both times, mowing was made by workers of routine and yield as green was weighed still in field. Yield values, evaluated by analyse variance, are summarized in Table 1.

Results

I. *Effect of trace element supplementation on yield.* (Results adjusted at 5 per cent significance.)

1. *Microelements alone* (Series I.) produced an increase, 37 per cent by molybdenum, 31 per cent by cobalt, 20 per cent by copper and 17 per cent by magnesium.

2. *Microelements accompanied by nitrogen fertilizing* (Series II.) showed plus yield, as 25 per cent by molybdenum, 16 per cent by cobalt, 12 per cent by boron, 9 per cent by manganese and 5 per cent by copper.

Table 1

Yields in

Trace elements given	Trace elements only			Same					
				"Linzer salt"			"Superphosphate"		
	100 kg per kh	Plus yield	%	100 kg per kh	Plus yield	%	100 kg per kh	Plus yield	%
1 Untreated	35	—	100	73	—	100	47	—	100
2 B	37	2	106	82	9	112	50	3	106
3 Mo	48	13	137	91	18	125	77	30	164
4 Mn	38	3	108	80	7	109	49	2	104
5 Co	46	11	131	85	12	116	69	22	147
6 Cu	42	7	120	77	4	105	47	—	100
7 Mg	41	6	117	65	—	89	50	3	106
8 Fe	40	5	114	76	3	104	43	—	91
9 I	36	1	103	73	—	100	49	2	104
Sign. 5%		5.1	14.5		3.3	4.5		14.6	31.1
Experimental mean	40		114	78		107	53		113

3. *Microelements plus phosphorus fertilizers* (Series III.) produced strikingly high increase, where molybdenum (64 per cent plus yield) and cobalt (47 per cent plus yield) was added.

4. *Potassium ground fertilizer combined with trace elements* (Series IV.) gave positive response only in molybdenum and iodine treated parcels (32 per cent plus in each).

5. *Nitrogen—phosphorus—potassium* (NPK) and trace elements combination (Series V.) each in quantities used in 1—4 experimental arrangements, brought only plus (24 per cent) when molybdenum was given.

6. *Trace elements combined with urea (5 per cent) fertilizer* (Series VI.) produced positive effect in combinations of molybdenum (42 per cent), cobalt (37 per cent), iron (23 per cent) and iodine (19 per cent).

Based on the results of a year, we may state that trace element supplementation on pastures of this country can increase the yields, though within moderate limits. Depressions due to trace element addition did not prove to be significant.

The results of fertilizing with bigger amount of ground fertilizers combined with trace elements cannot be regarded as concordant, and their positive effects are due to an increased effectivity of ground fertilizers and the effects of ground fertilizers are elevated up to the level of significance. Magnesium, given alone, produced a small yield (17 per cent). Combined with ground fertilizers neither plus yield nor depression could be found. These findings support *experiments*

trace element added to								
"Potassium salt"			"NPK"			Urea		
100 kg per kh	Plus yield	%	100 kg per kh	Plus yield	%	100 kg per kh	Plus yield	%
37	—	100	85	—	100	43	—	100
42	5	114	97	12	114	41	—	95
49	12	132	105	20	124	61	18	142
37	—	100	99	14	116	42	—	98
48	11	130	101	16	119	59	16	137
39	2	105	85	—	100	44	1	102
36	—	97	82	—	96	44	1	102
39	2	105	84	—	99	53	10	123
49	12	132	89	4	105	51	8	119
	11.6	31.3		19.9	23.4		4.0	9.3
42		114	92		108	49		114

the statement of Győri (1963) who thinks that Mg supplementation of Hungarian moor-field soils is unnecessary. The yields of experimental fields — containing relatively few soluble phosphorus in soil — showed exactly the close interaction existing between the effectivity of traditional ground fertilizers and microelement supplements and the property of the soil. This phenomenon could be particularly well observed in molybdenum combinations.

Advantageous accessory responses were also found, such as accelerated growth, i.e. advantage in pasturing and earlier harvesting. Botanically, the composition of grass constituents showed an advance of valuable species. This advance was mainly due to nitrogen effect, but microelement had also favourable effect. In comparison with the coenosis of controls, *Gramineae* dominated with 12—17 per cent of weight, *Papilionaceae* with 7—9 per cent, while weeds were suppressed with 22—33 per cent.

Although the intense advance of *Cyperaceae-Juncaceae* groups seems to be discrepant, but it can be explained by influenced subsoil water conditions, due to irrigation in the vicinity.

II. *Influence of microelement supplementation on mineral composition of vegetation*

Trace element fertilizers on pastures have their chief advantage in supplying a satisfactory mineral requirement for the productive animal organism. In order to detect changes in vegetal mineral composition after certain trace element treatments, samples of both harvests were taken and analysed in laboratory.

It can be stated that in respect of nutrition only small changes could be found in minerals of second yield (Table 2).

Table 2

Changes in mineral content of graminaceous seed of second harvest after treatment with microelements

Trace element treatment	CaO	K	Na	P_2O_5	Fe	Mn	Zn	Cu	Mo
	g/kg				mg/kg				
B	6.6	13.5	1.12	5.9	170	74	30	7.3	2.7
Mo	6.0	14.6	0.56	5.2	140	85	22	6.8	14.9
Mn	5.9	16.4	0.56	6.1	150	102	19	6.0	2.3
Co	6.0	16.5	0.51	5.7	175	112	17	4.9	1.4
Cu	5.5	16.5	0.51	6.0	130	125	25	7.6	1.4
Mg	6.0	17.3	0.66	6.5	147	129	21	5.7	1.1
Fe	5.8	14.9	0.54	5.6	142	122	—	7.0	1.1
I	5.9	13.8	0.60	5.1	138	110	19	4.6	1.0

However, in parcels treated with molybdenum, the quantity measured was ten times more, in other combinations changes were nutritionally unimportant and under the limit of significance.

Since among secondly harvested hays only molybdenum increased the corresponding mineral content, first harvest samples from Mo, Mn, Cu, and Fe series have also been analysed. *Agrostis alba* has given in six repetitions the results in Table 3. According to these, we may state that even in first harvest samples only molybdenum has increased trace element concentration in hay. These increases have exceeded the maximum of 15 ppm found in second harvest samples and they are evidently toxic.

Table 3

Effects of four microelements on mineral composition of the first mow of Agrostis albae

Trace element treatment	CaO	K	Na	P_2O_5	Fe	Mn	Zn	Cu	Mo
	g/kg				mg/kg				
Mo	7.7	16.8	0.57	3.5	98	45	24	10.0	66.6
Mn	3.5	16.2	0.33	4.1	71	39	28	7.0	1.3
Cu	2.5	19.2	0.23	5.1	69	37	27	8.6	1.3
Fe	3.8	18.4	0.37	4.7	75	34	31	10.5	1.3

Table 4

Effects of N and NPK plus trace element compositions on minerals of Carex acutiformis in comparison with the treated one with microelements only

Treatment	CaO	K	Na	P_2O_5	Fe	Mn	Zn	Cu	Mo
	g/kg				mg/kg				
Trace elements + N	5.8	15.0	0.37	6.1	110	115	27	6.5	1.6
Trace elements	4.8	14.2	0.52	6.2	97	100	21	5.1	0.88
Trace elements + NPK	5.2	12.3	0.79	5.2	75	130	17	6.5	1.2

Significant differences could be found, when effects of N and NPK plus microelements were analysed. Table 4 shows the difference, on the example of *Carex acutiformis*, taken the average of 8 analyses. This suggests that minerals in hay with exception of sodium and phosphorus were enriched when nitrogen ground fertilizer was used. Ground fertilizing of NPK type caused only small change, as faint depression in Zn, Fe, P and K concentrations, negligible nutritionally, but slightly improved resorption of Ca, Na, Mn, Cu and Mo. Similar increase of vegetal manganese content was established by GYŐRI (1963), as a response to NPK complex fertilizer. Equally N and NPK fertilizers intensified with 27 per cent copper resorption in hays. This finding is in accord with the observations of BOSCH (1954), HAVRE—DISHINGTON (1962) and others.

Valuable interactions could be revealed between the trace element content of soil and quantities of supplemented microelements.

As basis of comparison, only mobile trace ions were taken into consideration and not total ion content. According to the analyses, the upper 20 cm layer of each parcel contained 16 g of total molybdenum, 0.8 g of that in mobile form. The same soil quantity contained 8000 g of manganese, 800 g in mobile form. In the same time, on experimental parcels 39 g molybdenum or 16 g manganese had been given as fertilizer. As a comparison of mobile ions of soil and quantity of certain element given, it can be stated that molybdenum is in 49 times quantity, but manganese only in 1/50 quantity given (Table 5).

These proportions explain the augmentation of molybdenum content and the persisting of manganese levels in hay samples. Similar interaction could be found when magnesium and copper were analysed, since both represented only a small part of mobile trace ions of soil.

Striking effect has been observed on parcels treated with boron. Hays of these parcels have the lowest manganese but the highest zinc levels (Table 6). While manganese — zinc quotient was 2.0 in boron treated parcels, in other combinations it was found 5.5. Earlier, one of us (TÖLGYESI 1964) had already stated similar fall of manganese and raise of zinc, when pasture had been

Table 5

Quantitative proportion of microelements of soil and the fertilizing amounts spread

20 cm superficial layer contained		Trace element distributed at one parcel, g	Fertilizer/soil proportion	
total	mobile		total	mobile
g				
16 Mo	0.8 Mo	39	2.4	49
8000 Mn	800.0 Mn	16	$\frac{1}{500}$	$\frac{1}{50}$

Table 6

Changes in mineral composition of graminaceous and moor grasses after fertilizing with boron

Plant	Treatment	Mn	Zn	Mn/Zn quotient
		mg/kg		
Alopecurus pratensis	Mg + N I mow	34	21	1.6
,, ,,	B + N I mow	29	27	1.1
Carex acutiformis	Mg + K II mow	227	23	9.9
,, ,,	B + K II mow	188	45	4.2
,, ,,	Mg + K II mow	290	24	12.0
,, ,,	B + P II mow	148	29	5.1

fertilized with gyps—boric acid combination. Then the possibility of diminishing effect of boron on Mg/Zn quotient had been already raised.

In order to fortify the existence of this correlation, we have carried out further investigations. Therefore, the effect of magnesium addition having in its quantity practically negligible effect on soil mineral changes was directly compared with the changes caused by boron supplementation. Results summarized in Table 6 suggest that in all the three combinations boron has reduced Mn/Zn quotient more or less expressively. A particular diminution of manganese concentration was clearly observable in the mineral content of *Carex acutiformis*. Anyway, grasses on moor fields (*Carex*, *Juncus* sp. etc.) contain particularly high amounts of manganese (HARASZTI—TÖLGYESI 1961). In the literature such an effect of boron supplementation has not been reported.

Therefore, we think that zinc enriching and manganese depriving effect of boron must be ranged into the series of acknowledged antagonisms and synergisms in trace element interactions.

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CHARACTERIZATION OF SOME PARAMETERS OF ION TRANSPORT AND TRANSLOCATION, I

EFFECTS OF ISOLATION AND PRELOADING ON BROMIDE TRANSPORT

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The effects on the parameters of bromide absorption and leakage from wheat seedlings and their excised roots of pretreatment (preloading) with identical ions have been studied.

The preloading particularly reduces the $V_{\max}$ of the influx of the transport process that becomes saturated at low concentration. The preloading effect can already be experienced within two hours and a period of approximately 10 to 12 hours is necessary for its maximum development. In excised roots the demonstration of the preloading effect is made more complicated by another influence brought about by isolation. As a result, the bromide influx of excised roots increases on both $CaSO_4$ solution and $CaSO_4$ solution containing bromide ion, but to a lesser extent in the latter case.

Preloading decreases rather than increases the leakage of bromide from excised roots.

It is essential to take into consideration the preloading and isolation effects when comparing the ion transport parameters of different species and varieties.

Introduction

Since the carrier theory of the ion transport of higher plants was first outlined in detail (Epstein—Hagen 1952) a vast experimental material on the inorganic ion uptake by different plants and their excised roots has been collected (Fried—Shapiro 1961, Epstein 1966). According to this kinetic treatment the parameters that are characteristic of the process are the maximum rate ($V_{\max}$) referred to fresh weight and the concentration (K_m) necessary to obtain half of the maximum rate.

In recent years there have been certain modifications to some details of the original model and it has come under criticism (Russel 1962, Briggs—Robertson 1957, Bange 1962, Page—Dainty 1964, Hodges—Vaadia 1964b, Torii—Laties 1966, Bange—Hooymans 1967), but in spite of this it has remained to be a useful means of describing and comparing the kinetic characteristics of transport processes. Of the modifications to the model the most remarkable one is the recognition that while being examined over a wider concentration range the transport seems to be resolvable into two parallel mediated processes the K_m-s of which differ from one another in a ratio of 1 : 100—1000 (Fried—Noggle 1958, Bange 1959, Epstein—Rains—Elzam 1963). The process that becomes saturated at lower concentration is generally called process No. 1 (b or L) while the one that is effective at higher concentration is usually referred to as process No. 2 (a or H).

EPSTEIN *et al.* (1964,) 1965) have recently stated that in the case of chloride and alkali cations process 2 is also a compound one and it can be resolved into 3—4 systems with a slightly different affinity. It was also pointed out that over a higher concentration range a part of the transport is likely to be non-mediated (BANGE—OVERSTREET 1960, HOOYMANS 1964). According to our own data (BÖSZÖRMÉNYI 1966a, BÖSZÖRMÉNYI 1966b) non-mediated transport is very probable to account for only a small proportion of absorption taking place at high concentration. Because the data are partly contradictory and partly because they are not yet sufficiently detailed the question of the further division of process 2 cannot at present be regarded as closed.

Comparative data (FRIED—SHAPIRO 1961, JACKMAN 1965, SHIM—VOSE 1965, OTT 1963, BÖSZÖRMÉNYI 1966a, BÖSZÖRMÉNYI 1966b) on the parameters of ion transport, which are now available, indicate that the differences between species and varieties are likely to be revealed to a much greater extent in the $V_{\max}$ of the transport processes than in the differences between the K_m values. We concluded in our previous papers that the bromide transport of both the wheat and barley seedlings and their excised roots can be described with a double mediated process the K_m values of which remain comparatively constant even if the materials under examination have been grown under different conditions. However, we obtained differences in the $V_{\max}$ (particularly in process 1), depending on the treatment given to the plants previously. The objective of the present report is to make — in seedlings and excised roots — a more detailed study of the development of the "preloading" effect observed. As you will see later with the excised roots there is also another change deriving from the isolation and added to the preloading effect.

Materials and Methods

F. 481 winter wheat was used in the majority of the experiments. In some experiments with barley, mentioned in this paper, partly the "Herta" varieties from the Netherlands (Fig. 4) and partly domestic barley bought without the varieties being marked (Fig. 2) were employed.

Two methods were adopted while growing the plants. The first one supplied the data for the time-course of uptake (Table 1) and for variants Nos 2 and 5 of Fig. 2. This method is in essence identical with the one we used in previous experiments (e.g. 9). The seeds were germinated for three days in darkness at 26° C on filter paper wetted with distilled water. The roots were excised right before the experiments were due and (in contrast to the previous experiments) they were kept for a few minutes in 2.5 mM $CaSO_4$ before use. One variant was composed of the roots of 20 plants (approximately 550 to 600 mg fresh weight). The fresh weight was determined with a parallel sample and the data were calculated to 1 g.

Since the method of germination described above is not suitable for giving pretreatment to seedlings with different solutions in the majority of experiments the material was grown in water culture. There was only a light deviation from the method applied in the Department of Botany, State University, Leiden (BÖSZÖRMÉNYI 1966a). The seeds, having been disinfected with 1.5 per cent H_2O_2, were aerated 24 hours in distilled water. The seeds were then placed on nylon sieve cloth between two layers of gauze and grown for three days on 2.5 mM $CaSO_4$ in trays. In certain variants (Figs 5—7 and 9—10) the $CaSO_4$ solution was replaced on the third day by $CaSO_4$ solutions containing KBr. The solutions were changed every day. The cultures were kept at 26° C in darkness and were not aerated.

Before the experiments were due the roots had been cut under the gauze layer and the solution adhering to them removed with low rate centrifuging. After centrifuging the roots, samples (0.25 or 0.50 g) were taken quickly and transferred immediately into the required solution.

When pretreatment was given to the excised roots (Fig. 8) before the uptake period, it took place in shaken 50 ml solutions for 1 to 8 hours at room temperature. Normally the roots got into the uptake solution within one to one and a half hours after having been excised. They spent most of this period in solutions identical with the one used for germination. (An exception is the measurement of their fresh weight when they are wrapped up in wet gauze.)

In each case the uptake solution contained $CaSO_4$ in 2.5 mM concentration (except for the Ca-free solution of Nos 2 and 5 variants of Fig. 2). The absorption took place from 50—100 ml aliquots which were aerated by shaking. At the end of the uptake period the solutions were filtered through a Büchner funnel and the roots were washed with 2 × 50 ml distilled water (for about 20 seconds).

In the "efflux" experiments the solution was sucked down at the end of the absorption period and the roots were transferred into the respective inactive solution without being washed. The efflux period ended with the usual washing. In part of the efflux experiments (Fig. 10) the treatment with radioactive solution began on the third day of germination, while the excised roots were kept in a radioactive solution of identical specific activity before and during the uptake period. In another variant of this experiment the roots were placed into the labelled solution only during the absorption period.

The samples labelled with Br^{82} isotope were measured with well-type scintillation measuring head which was attached to a Frieseke-Hoepfner scaler. In order to determine the bromide content chemically the samples were ashed and titrated electrometrically with Metrohm E 166 titriscope (BÖSZÖRMÉNYI—CSEH 1964).

Each variant was run in two or more repetitions, and in most cases the separate experiments were repeated several times. The data presented in the Tables and Figures represent the averages of generally two repetitions. In order to spare space all similar experiments will not be discussed (except for Figs 9 and 10 which contain the data of two independent experiments).

Results

The time-course of uptake. The time-course of bromide uptake by excised wheat roots in 2.5 mM $CaSO_4$ was studied in a number of experiments (Table 1). The measuring covered a period of 60 minutes with 5, 10, 20, 40 and 60 minute measuring intervals. The absorption was approximately linear at every concentration, a more detailed analysis of the data, however, indicated that while by the end of the measuring period the rate of absorption slightly rose at lower concentrations, at higher concentrations (over 10 mM) it was rather a reduction of the rate that had to be reckoned with. With the experimental technique adopted the time curves gave a positive ordinate section in the majority of the cases. Compared to the rate of uptake the ordinate section gives an approximately straight line in the function of the concentration. At 0.01 mM it accounts for only 1 per cent of the 1 hour absorption, but at 30 mM it amounts to 5 per cent. The slight deviations from the linearity of the time curves or the small ordinate sections did not modify significantly the concentration curve of absorption.

The course of the time curve remained to be approximately linear even when the excised roots had been incubated for a varying time (1 to 3 hours) in 2.5 mM $CaSO_4$ or in $CaSO_4$ containing bromide before the absorption period

Table 1

Bromide uptake by excised wheat roots in the presence of 5 m. equiv. Ca^{++}. (Determined from time curves obtained at different concentrations and calculated to 1 g fresh weight/hour in μ equiv.)

External concentration, mM	Ordinate section μ equiv./g fresh weight	Rate of absorption calculated from the difference of	
		10 and 5	60 and 40
		minutes data	
0.01	0.0009	0.05	0.07
	0.0005	0.05	0.06
0.03	−0.0005	0.13	0.15
	0.0022	0.12	0.18
0.1	−0.0037	0.27	0.33
	0.0023	0.24	0.26
0.3	0.0072	0.39	0.46
	0.0071	0.27	0.38
1	0.023	0.99	1.13
	0.008	0.86	0.79
3	0.057	1.46	1.79
	0.066	1.30	1.52
10	0.081	3.50	3.36
	0.083	4.75	3.24
20	0.086	8.07	6.46
30	0.254	5.84	5.55
	0.317	7.68	7.98

(Fig. 1). Both pretreatments increased the rate of uptake (the increase on $CaSO_4$ being somewhat greater and this accounts for the gradual divergence of the two curves).

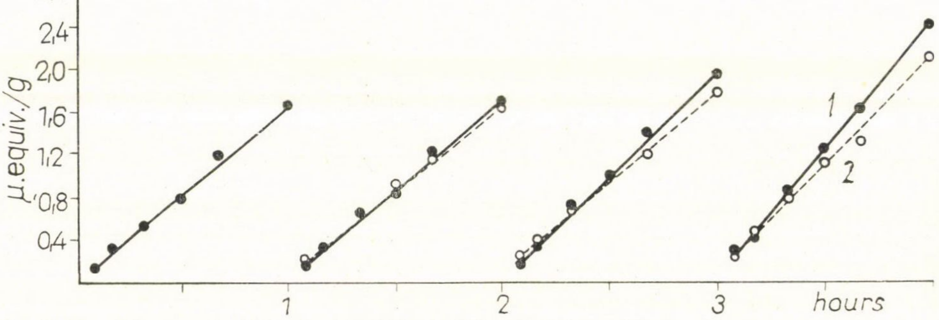

Fig. 1. Bromide uptake from 1 mM KBr + 2.5 mM $CaSO_4$ solution by the excised roots of wheat seedlings grown on $CaSO_4$ solution after pretreatment of varying duration on 2.5 mM $CaSO_4$ (1), or on 1 mM KBr + 2.5 mM $CaSO_4$ (2)

The concentration curve of uptake. The parameters of the bromide absorption by the excised roots of wheat and barley seedlings grown according to the usual method (in darkness on diluted $CaSO_4$) do not remarkably differ from one another (Fig. 2). The concentration curve of bromide uptake shows dual saturation [but as we pointed out earlier (Böszörményi 1966c), a break referring to a process saturating at an intermediate concentration can be observed in some cases]. The absence of Ca during the uptake period increases the K_m of process 1. In short experiments the concentration curves of bromide absorption by excised roots and intact seedlings are identical (Böszörményi 1965), a phenomenon which we interpreted as the bromide uptake by the roots limiting the bromide absorption by the whole plant.

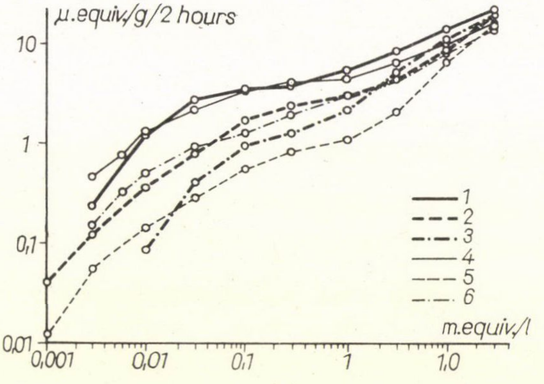

Fig. 2. Bromide uptake by excised roots of wheat and barley seedlings grown under different conditions; 1) barley, grown in darkness, uptake from 2.5 mM $CaSO_4$ solutions, 2) barley, germinated in darkness, uptake from Ca-free solutions, 3) barley, grown during 18 : 8 hours photoperiod uptake from 2.5 mM $CaSO_4$ solutions, 4—6) similar treatments with wheat

The quantity of bromide accumulated by intact wheat seedlings in longer experiments (48 hours) also shows a complex concentration dependence similar to that of the shorter uptake experiments (Fig. 3). In our opinion the section of the curve over 1 mM belongs to process 2 and the curve shows that process 1 (under 0.1 mM) is strongly inhibited under such conditions. We suppose that the break that can be observed at 1 mM can be traced back to a third process mentioned earlier. This is used to be called system M (Böszörményi 1966a). This interpretation is supported by experiments made with excised roots of preloaded barley seedlings which, in the case of inhibition of process 1, show a break also at 1mM (variant No. 3 of Fig. 4).

Preloading and isolation effects. Setting out from our previous observations in which we had primarily experienced a decrease in the activity of system 1 (Böszörményi 1966b) in intact seedlings after a 48-hour preloading treatment, in the present series of experiments we studied the formation of the preloading effect in intact seedlings and excised roots.

In the case of intact seedlings the transport is inhibited quickly at the initial stage, with the maximum effect being approached within some 10—12 hours (Figs 5—7). While trying to apply the results obtained with intact plants to excised roots we were surprised to experience that the inhibitive effect of preloading was comparatively slow to develop (e.g. Fig. 1). An explanation to this lies in the fact that the isolation brings about a gradual increase in absorption (Fig. 8), and in this case the preloading only slows down the rate of this rise. The increase in the uptake can already be detected at the first point of measuring and it extends to about 6 to 7 hours. Isolation effect takes place in the excised roots of seedlings grown on both $CaSO_4$ or $CaSO_4$ + KBr solution. As expected the preloading effect is substantially higher in the roots of plants grown on $CaSO_4$.

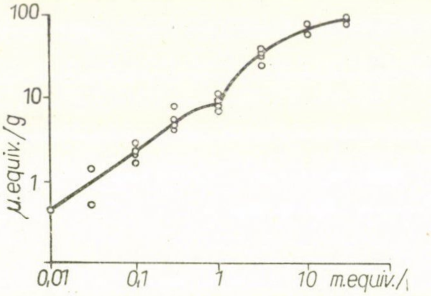

Fig. 3. Bromide content of the roots of wheat seedlings grown for 48 hours after germination in darkness on $CaSO_4$ solutions containing KBr

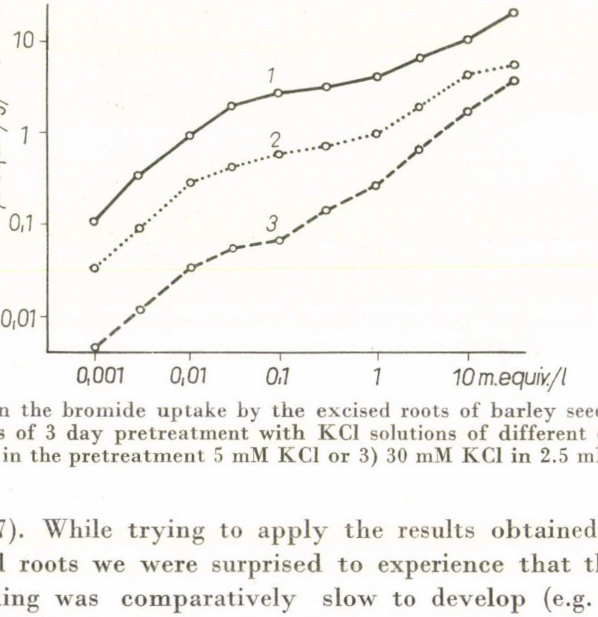

Fig. 4. The effect on the bromide uptake by the excised roots of barley seedlings from 2.5 mM $CaSO_4$ solutions of 3 day pretreatment with KCl solutions of different concentrations; 1) control, 2) in the pretreatment 5 mM KCl or 3) 30 mM KCl in 2.5 mM $CaSO_4$

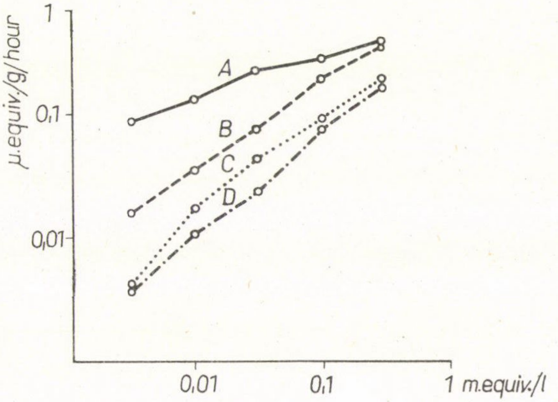

Fig. 5. The effect on the bromide uptake from 2.5 mM $CaSO_4$ solutions of pretreatment of varying duration with 3 mM KBr; A) control, B) the length of pretreatment 3 hours, C) 15 hours and D) 48 hours

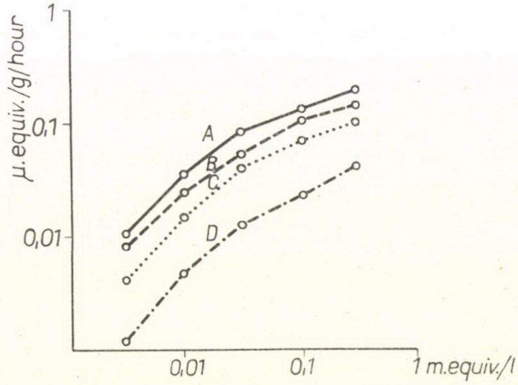

Fig. 6. The effect on the bromide uptake from 2.5 mM $CaSO_4$ solutions of pretreatment of varying duration with 3 mM KBr; A) control, B) the length of pretreatment 2 hours, C) 6 hours and D) 48 hours

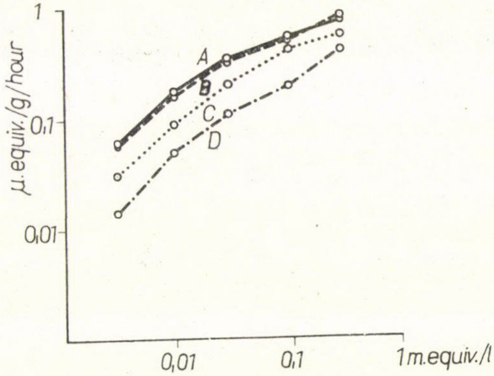

Fig. 7. Text is identical with that of Fig. 6

Efflux curves. The rate of bromide leakage from excised roots amounts to 10 or maximum 20 per cent of the absorption. There is no difference in the leakage either in distilled water or in the solutions of different halides (Cseh—Böszörményi 1961). Although the process is supposed to be passive and non-mediated, the time curve of this efflux does not generally follow the simple exponential course that can be expected on this basis. This deviation can be ascribed to various reasons, for instance, dissimilarities in sizes of the cells, the occurrence of several compartments in the cells, the bleeding of the excised roots, and so on. It follows from what has been said that no unified position on the parameters which would be correct to characterize the bromide "efflux" of roots has so far been reached.

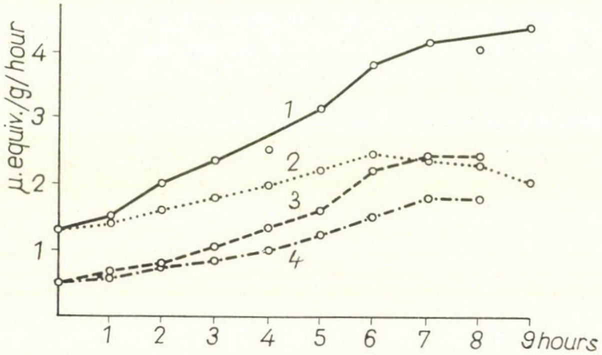

Fig. 8. Bromide uptake by excised roots of wheat seedlings from 1 mM KBr + 2.5 mM $CaSO_4$ solution during an absorption period of 30 minutes; growth of seedlings on $CaSO_4$ (1, 2), or $CaSO_4$ + 1 mM KBr (3, 4); incubation of excised roots on $CaSO_4$ (1, 3) or on $CaSO_4$ + 1 mM KBr (2, 4)

The bromide leakage from preloaded roots grown on $CaSO_4$ was studied in numerous experiments. The data (Fig. 9) indicate that the preloading decreases rather than increases the leakage from the roots.

The lesser leakage of labelled bromide (Fig. 10) from roots receiving pretreatment for over a longer period with radioactive bromide solution is likely to be ascribed to the fact that the labelled bromide accumulates in the vacuole pool from where it is slower to leak out.

Discussion

It is generally customary to discuss the decrease in the rate of the net absorption in experiments made with excised roots of higher plants as being the result of a reduction in the influx and an increase in the efflux. In the experi-

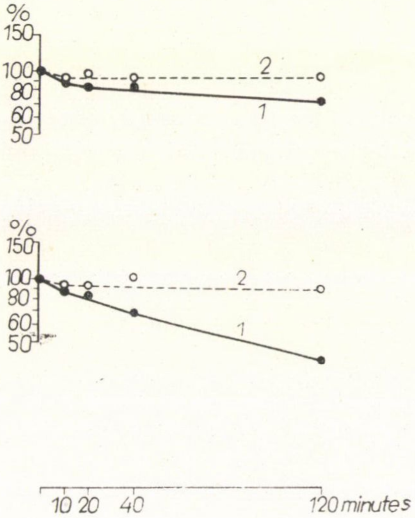

Fig. 9. Bromide leakage from the excised roots of wheat seedlings; 1) growth of seedlings on 2.5 mM $CaSO_4$ or 2) on 2.5 mM $CaSO_4$ + 3 mM KBr. Uptake period one hour on 2.5 mM $CaSO_4$ solution containing 3 mM labelled KBr, efflux on inactive solution of identical composition

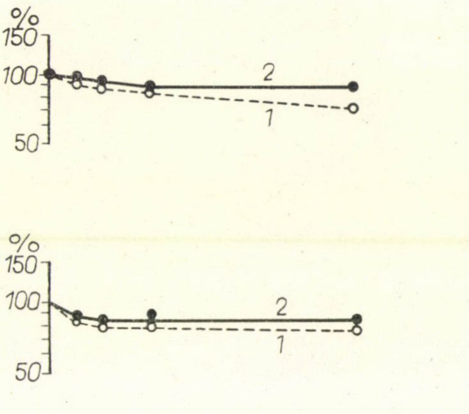

Fig. 10. Bromide leakage from the excised roots of wheat seedlings. Uptake period one hour on 2.5 mM $CaSO_4$ solution containing 3 mM labelled KBr, leakage on inactive solution of identical composition. The seedlings were grown on 2.5 mM $CaSO_4$ solution containing 3 mM inactive (1) or labelled (2) KBr; in the latter case the specific activity of bromide during growth and the uptake period was identical

ments described above two kinds of deviations from the linear course of bromide absorption have been obtained: a rising tendency at lower concentrations and a declining trend in some cases at higher concentrations. In our opinion both effects primarily stem from the change in the influx, namely, the increase can be an isolation effect, with the inhibition being a starting preloading influence.

Under our experimental conditions the efflux from isolated roots was generally low, and under the influence of preloading it decreased rather than increased. (However, bromide efflux from isolated roots is supposed to be a complex phenomenon and further studies are necessary for characterizing it more exactly.)

The ordinate section of the absorption time curves used to be considered a quantity of ions bound to the carriers (HAGEN—HOPKINS 1955, HAGEN—LEGGETT—JACKSON 1957, FRIED—NOGGLE—HAGEN 1958). The data we obtained (the linear dependence of the ordinate section on the concentration) do not support this conception and they rather point towards the idea that the ordinate section is the consequence of the initial entry of ions (BRIGGS 1957, BRIGGS—HOPE—PITMAN 1958, BRIGGS—ROBERTSON 1957, DAINTY—HOPE 1961, SHONE 1966, SHONE—BARBER 1966). At present the issue is still open whether the initial entry is Donnan distribution or a consequence of a system of electric double layers or what transitional state is effective between the two extreme suppositions.

Since the observation of HOAGLAND—BROYER (1936) that the excised roots of barley seedlings having received a better supply of nutrients before the uptake experiment through a more frequent change of the nutrient solution absorb lesser bromide, the view that a lower "salt-content" is favourable for ion uptake has become generally widespread.

Subsequent literature, however, refers to a wide variety of different phenomena as being "salt effect". For instance, it has been described that plants lacking the major nutrients (N, P, K) absorb a larger quantity of the element in question than the controls (HUMPHRIES 1951, HOFFMANN 1966). In such experiments, however, the symptoms of deficiency cannot for certain be separated from the primary change of the transport processes. It appears to be more advisable to work with such an ion that is more or less indifferent to metabolism and to carry out possibly short experiments. The chloride or bromide ion seems to be particularly suitable for this purpose.

The effect on the chloride absorption by *Vallisneria* leaves of pretreatments containing chloride ion has been studied by SOL (1958) who attributes the effects he achieved exclusively to the cations. According to HODGES—VAADIA (1964a, 1964b) chloride pretreatment reduces the uptake by onion roots of chloride and promotes translocation in certain cases. However, these experiments, because of the special technique adopted, cannot be compared with the studies mentioned in the introduction — in which the parameters of the transport processes were determined.

We pointed out earlier (Böszörményi 1966b) that the pretreatment of plants with halide ions decreased the rate of transport process 1 in their excised roots. The data presented in this paper confirm this conclusion. Although a period of 10 to 12 hours is necessary for the maximum development of the preloading effect, it can already be observed within two hours. The preloading effect can be produced also in excised roots, but here its formation is made more complicated by a rise in absorption that derives from the isolation of the root.

The increase in the ion accumulation of plant storage tissue slices while being washed (so-called "ageing") has been known and studied in detail for quite a long time. Lüttge—Laties (1967) separated the stele and cortex of maize roots and used the two tissues in transport experiments. The ageing of the stele would activate transport system 1 exclusively, while in the cortex tissues the activity of both systems would increase. On the basis of our own experiments made with excised (but otherwise intact) roots conclusion can be drawn towards the activation of system 1. (Possible changes in system 2 have not been examined.) The isolation effect is very quick to develop in the roots and this is where the difference lies between them and the analogous change in the storage tissue slices, the development of which requires several days of washing.

On the basis of our results we think it possible the preloading and isolation effect to be an identical step of the transport process (for example, the synthesis or activation of a carrier of protein nature), and that its action is similar to the enzyme regulation mechanisms.

We pointed out earlier (Böszörményi 1966c) that an exact standardization of the growth of the experimental material and the conditions of the uptake experiment are indispensable for drawing a comparison between the ion transport parameters of the different species and varieties. The roots of seedlings grown in darkness on diluted $CaSO_4$ solution can produce parameters that very substantially differ from the normally supplied (therefore more or less preloaded) roots of plants. Because of the isolation effect the absorption experiment must be made immediately after obtaining the roots; preliminary washing of the roots cannot be permitted. The absorption experiment itself should possibly be short, but the difficulties in defining the initial entry which can cause considerable error in a short uptake period can draw a limit to this.

Acknowledgements

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STUDIES ON THE DIFFERENTIATION OF THE GENERA AGROBACTERIUM AND RHIZOBIUM SPECIES BY SYNTHETIC DYES

By

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Four synthetic dyes, Malachite Green, Brilliant Green, pyronin and thionin, were incorporated in yeast water mannitol salts, agar and broth at the rates of 320, 80 and 20 ppm. Fifteen strains each of *R. meliloti*, *R. trifolii*, *R. leguminosarum*, *R. japonicum*, cowpea rhizobia, *R. lupini* and *A. radiobacter*, 12 strains of *A. tumefaciens* and 18 strains of *Rhizobium* spp. were streaked on dye agar and cultivated in dye-containing broth.

In relative to 80 ppm dyes in agar, the strains of agrobacteria and *R. meliloti* strains showed a high tolerance of each of the four dyes. *R. trifolii*, *R. leguminosorum* and *R. phaseoli* were of low, intermediate and high tolerance of pyronin and thionin, respectively; all the strains showed a low tolerance of Malachite Green. *R. japonicum*, cowpea rhizobia and *R. lupini* were sensitive to Malachite Green, Brilliant Green and thionin.

Introduction

The use of dyes for the isolation and differentiation of bacteria has been reported. Species of *Brucella* were differentiated by thionin and pyronin (HUDDLESON, 1931) and safranin 0 (JONES 1964). Strain 19 *Brucella* was distinguished by thionin (MORGAN 1961). *Azotobacter* species were differentiated by pyronin, diamond fuchsin, Malachite and Brilliant Greens (CALLAO—MONTOYA 1960).

This study was aimed at seeking a satisfactory dye-medium to differentiate between species of the genera *Rhizobium* and *Agrobacterium*.

Material and Methods

Twenty seven strains of two species of *Agrobacterium* and 123 strains of rhizobia were used.

Yeast water mannitol salts, known conventionally as medium 79 (ALLEN 1957), agar and broth were employed as basal media.

Four synthetic dyes with the following specified colour indices were studied; Malachite Green, 627; Brilliant Green, 42040; pyronin B, 45010; and thionin, 52000.

The dyes were added to the media in concentrations of 20, 80 and 320 ppm before sterilization.

Loopful inocula of 72-hour growing cultures were streaked on and inoculated into dye-containing agar and broth media, respectively. Number of rhizobial cells by this time ranged from 200—300 T cells/loop. Agrobacteria were of the order of one million cells/loop. After 6 days of incubation at 27° C the number of strains that showed colonial growth on dye-agar was recorded; growth or survival of the strains in the dye-containing broth medium was ascertained by streaking each culture onto dye-free medium 79 agar. Results were taken after another 6 days of incubation.

Results

On Malachite Green agar (Table 1), with the exception of one strain of *R. meliloti*, none of the rhizobia tolerated the 320 ppm concentration. Ten strains of *R. meliloti*, one to three strains of *R. trifolii*, *R. leguminosarum* and *R. phaseoli* and none of other groups of rhizobia showed colonial growth on 80 ppm Malachite Green agar. Thirteen *R. meliloti* strains and 3 to 11 strains of *R. trifolii*, *R. leguminosarum* and *R. phaseoli* but none of *R. japonicum*, cowpea rhizobia and *Rhizobium* spp. grew on 20 ppm Malachite Green agar. Fourteen *A. radiobacter* strains and six of the *A. tumefaciens* strains tolerated 320 ppm Malachite Green in agar; all *A. tumefaciens* strains tolerated 80 ppm.

Table 1

Number of strains tolerant to Malachite Green

Species	Number of strains tested	Malachite Green, ppm in					
		Agar			Broth		
		320	80	20	320	80	20
A. radiobacter	15	14	15	15	13	15	15
A. tumefaciens	12	6	12	12	10	10	12
R. meliloti	15	1	10	13	9	12	15
R. trifolii	15	0	1	3	0	0	7
R. leguminosarum	15	0	2	7	0	1	12
R. phaseoli	15	0	3	11	0	4	11
R. japonicum	15	0	0	0	0	1	13
Cowpea rhizobia	15	0	0	0	0	3	12
R. lupini	15	0	1	2	1	3	7
Rhizobium spp.	18	0	0	0	4	13	16

In Malachite Green broth (Table 1), thirteen strains of *A. radiobacter* and ten strains of *A. tumefaciens* tolerated the 320 ppm level and practically all the strains grew in the presence of 80 ppm Malachite Green. Nine strains of *R. meliloti* and one and four strains of *R. lupini* and *Rhizobium* spp., respectively, survived 320 ppm Malachite Green in broth; none of the rest of rhizobia did. Twelve strains of *R. meliloti* and *Rhizobium* spp., one to four strains of *R. leguminosarum* *R. phaseoli*, *R. lupini*, *R. japonicum* and cowpea rhizobia survived 80 ppm Malachite Green. The number of strains tolerant to 20 ppm Malachite Green in broth was between onehalf and all the strains of each group of rhizobia.

The strains of *A. tumefaciens* and *A. radiobacter* were highly resistant to Brilliant Green in agar and broth; nearly all the strains survived the 320 ppm level (Table 2). The rhizobia strains composed two groups; a) 2—7 strains of

Table 2

Number of strains tolerant to Brilliant Green

Species	Number of strains tested	Brilliant Green, ppm in					
		Agar			Broth		
		320	80	20	320	80	20
A. radiobacter	15	14	15	15	13	15	15
A. tumefaciens	12	10	12	12	10	12	12
R. meliloti	15	7	12	12	10	15	15
R. trifolii	15	2	7	11	2	15	15
R. leguminosarum	15	7	12	15	4	9	11
R. phaseoli	15	4	11	15	10	14	15
R. japonicum	15	0	0	0	4	11	11
Cowpea rhizobia	15	1	2	2	3	7	13
R. lupini	15	0	0	0	2	3	5
Rhizobium spp.	18	1	3	6	0	10	16

R. meliloti, *R. trifolii*, *R. leguminosarum* and *R. phaseoli*, and b) none of *R. japonicum*, the cowpea rhizobia, the strains of *R. lupini* and *Rhizobium* spp. tolerated 320 ppm Brilliant Green in agar. Number of strains that resisted 80 and 20 ppm Brilliant Green was increased markedly among the a) group but not among the b) group. Three and six strains of *Rhizobium* spp. tolerated 80 and 20 ppm dye, respectively.

In Brilliant Green broth (Table 2) a) ten strains of *R. meliloti* and *R. phaseoli*, and b) none to 4 strains of each group of the rest of rhizobia grew in the presence of 320 ppm level. The number of strains tolerant to 80 ppm Brilliant Green in broth was a) between 9 and 15 strains of *R. meliloti*, *R. trifolii*, *R. leguminosarum* and *R. phaseoli*, and b) between 7 and 11 strains among *R. japonicum*, cowpea rhizobia, *R. lupini* and *Rhizobium* spp. strains. At the 20 ppm level, the number of resistant strains in each of these groups increased.

On pyronin agar (Table 3), 14 and 10 strains of *A. radiobacter* and *A. tumefaciens*, respectively, grew in the presence of 320 ppm. Ten and 13 strains of *R. japonicum* and *R. phaseoli*, respectively, and between none to 7 strains of the remaining groups of rhizobia tolerated this pyronin concentration. At the 80 ppm level, a) 10—13 strains of *R. meliloti*, *R. phaseoli* and *R. japonicum*, and b) between 2 and 7 strains of the rest of rhizobia survived the pyronin in agar. Most strains in each group of rhizobia resisted the 20 ppm level of pyronin.

In pyronin broth (Table 3), 11 and 13 of cowpea rhizobia and *R. japonicum* strains, respectively, survived 320 ppm pyronin. Half to all the strains of rhizobia tolerated the 80 ppm of this dye. At 20 ppm pyronin in broth, near-

Table 3

Number of strains tolerant to pyronin B

Species	Number of strains tested	Pyronin B, ppm in					
		Agar			Broth		
		320	80	20	320	80	20
A. radiobacter	15	14	14	15	9	15	15
A. tumefaciens	12	10	12	12	6	12	12
R. meliloti	15	2	10	15	3	8	15
R. trifolii	15	0	2	12	0	0	7
R. leguminosarum	15	5	7	13	0	2	8
R. phaseoli	15	13	13	15	2	5	11
R. japonicum	15	10	12	14	13	15	15
Cowpea rhizobia	15	5	5	14	11	14	15
R. lupini	15	4	4	7	5	8	14
Rhizobium spp.	18	7	7	10	7	7	16

ly all strains of *R. meliloti*, *R. japonicum*, and cowpea rhizobia, 14 strains of *R. lupini*, 16 strains of *Rhizobium* spp. and 7 to 11 strains of *R. trifolii*, *R. leguminosarum* and *R. phaseoli* resisted the dye. Nine strains of *A. radiobacter* and 6 strains of *A. tumefaciens* survived 320 ppm pyronin in broth; all the strains in each group survived the 80 ppm concentration.

On thionin agar (Table 4), 14 strains of *A. radiobacter* and 4 strains of *A. tumefaciens*, 9 strains each of *R. meliloti* and *R. phaseoli*, between one to 3 strains of *R. trifolii*, *R. leguminosarum*, *R. japonicum* and cowpea rhizobia, and none of the *R. lupini* and *Rhizobium* spp. strains tolerated the 320 ppm level. Eleven and 14 strains of *R. meliloti* and *R. phaseoli*, respectively, tolerated 80 ppm thionin. From two to seven strains of the rest of rhizobia showed growth on 80 ppm thionin agar. At 20 ppm thionin in agar the number of tolerant strains in each group increased.

In broth (Table 4) few rhizobial strains survived 320 ppm thionin. At the 80 ppm level, 11 strains of *R. leguminosarum* and 15 strains of *R. japonicum*, strains of *R. phaseoli*, cowpea rhizobia and *Rhizobium* spp. ranged between 6 and 8, and only one to two strains — each of *R. meliloti*, *R. trifolii* and *R. lupini* — tolerated this dye concentration. Between 12 and 15 strains each of *R. meliloti*, *R. leguminosarum*, *R. phaseoli*, *R. japonicum* and cowpea rhizobia and three strains each of *R. trifolii* and *R. lupini* tolerated 20 ppm thionin in broth.

Nine strains of *A. radiobacter* and six strains of *A. tumefaciens* tolerated 320 ppm thionin in broth. All the strains survived the 80 ppm concentration.

Table 4

Number of strains tolerant to thionin

Species	Number of strains tested	Thionin, ppm in					
		Agar			Broth		
		320	80	20	320	80	20
A. radiobacter	15	14	14	15	9	15	15
A. tumefaciens	12	4	12	12	7	12	12
R. meliloti	15	9	11	15	0	2	15
R. trifolii	15	2	2	7	1	2	3
R. leguminosarum	15	1	7	12	2	11	15
R. phaseoli	15	9	14	15	0	6	12
R. japonicum	15	3	3	14	3	15	15
Cowpea rhizobia	15	2	6	13	0	7	15
R. lupini	15	0	3	7	0	1	3
Rhizobium spp.	18	0	0	13	2	8	14

In general, rhizobia used in these experiments were of the following characteristics in terms of tolerance of 80 ppm of the dyes in agar:

a) *R. meliloti* of high resistance to the different dyes.

b) *R. trifolii*, *R. leguminosarum* and *R. phaseoli* of low, intermediate and high tolerance, respectively, of pyronin and thionin and of low tolerance of Malachite Green.

c) *R. japonicum*, cowpea rhizobia and *R. lupini* species were of low resistance to Malachite Green, Brilliant Green and thionin.

Discussion

Early studies on the effect of dyes on rhizobia showed that strains of soybean and lupine rhizobia varied widely in tolerance of crystal violet (WRIGHT 1925, WRIGHT—SIMINGTON 1927, ECKHARDT *et al.* 1931). WRIGHT (1925) and WRIGHT—SIMINGTON (1927) reported two groups of soybean rhizobia, one of which was inhibited by 1 : 10,000 and the second by 1 : 100,000 crystal violet. ECKHARDT *et al.* (1931) showed that one lupine group tolerated up to 1 : 150,000 and a second group was sensitive to 1 : 150,000 crystal violet. KOBUS (1952) reported that the high resistance to 1 : 1000 crystal violet occurred among strains of *R. meliloti*, *R. phaseoli*, and *R. leguminosarum*. *R. japonicum* and *R. lupini* strains were especially sensitive to 1 : 150,000 crystal violet. Similar results are reported here. Strains of the different species of rhizobia grew or were inhibited by 320, 80 and 20 ppm of the dyes.

Based upon different bacteriological tests, pH, antibiotic resistance, carbohydrate fermentation and reduction of methylene blue, SMITH (1958) classified rhizobia into three groups: a) *R. meliloti*, b) *R. trifolii*, *R. leguminosarum*, *R. phaseoli* and c) *R. japonicum*, cowpea rhizobia and *R. lupini.*

Pursuant to the results of this study the grouping of rhizobia strains relative to sensitivity to 80 ppm of different dyes in agar can be as follows:

	Tolerance,		
	High	Mediate	Low
Malachite Green	*R. meliloti*	—	remainder of rhizobia
Brilliant Green	*R meliloti*	*R. trifolii*	*R. japonicum*
	R. leguminosarum	*R. phaseoli*	cowpea rhizobia *R. lupini*
Pyronin	*R. meliloti*	*R. leguminosarum*	*R. trifolii*
	R. phaseoli		*R. lupini*
	R. japonicum		cowpea rhizobia
Thionin	*R. meliloti*	cowpea rhizobia	*R. trifolii*
	R. phaseoli		*R. japonicum*
	R. leguminosarum		*R. lupini*

Because of the heterogeneity in tolerance of different dyes among the species and between the strains of one species, none of the tested dye-media was found satisfactory to differentiate between agrobacteria and rhizobia or within the species of each group.

Acknowledgement

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EFFECT OF CUTTING ON PLANT HEIGHT, TILLER AND LEAF NUMBER AND LEAF AREA OF WESTERWOLDS RYEGRASS (LOLIUM MULTIFLORUM VAR. WESTERWOLDICUM LAM.) GROWN UNDER FIELD CONDITIONS

By

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An experiment was carried out at the experimental farm of the faculty of Agriculture, Giza, U. A. R. to evaluate the effect of cutting on the growth of Westerwolds ryegrass (*Lolium multiflorum* var. *westerwoldicum* Lam.) when grown alone under field conditions. Cutting to 3 inches was done when the plants attained a height of about 80 cm.

The results indicated that cutting generally reduced plant height, tiller number, leaf number, and leaf area of this plant, indicating that this grass was very sensitive to cutting when grown alone under field conditions.

Introduction

Great attention has been directed in the last few years in the U.A.R. towards interseeding some grasses with Egyptian clover (*Trifolium alexandrinum* L.) in order to increase the forage yield and to improve its quality. Serviss—Ahlgren (1955) mentioned that grass-legume mixtures were credited with certain advantages over grasses alone or legume alone.

In Egypt, Egyptian clover is usually sown separately and constitutes about 75 per cent of the animal feed crop. Recently it was thought that interseeding with Westerwolds ryegrass and Italian ryegrass *(Lolium multiflorum,* Lam.) might give promising results.

The common name ryegrass, as reported by Wheeler (1956), is applied to a group of plants comprising two species of the genus *Lolium*: *multiflorum* and *perenne*.

From the agronomical point of view, cutting is considered one of the most important cultural practices for forages. However, grasses respond differently to this treatment. Jones—Jones (1930) indicated that the number of tillers of Italian ryegrass, Cocks-foot, and Timothy was greatly reduced by such managements, on the other hand, tillers of Bent and Fineleaved Fescue were increased considerably. Mitchell (1954) indicated that tillering of short-rotation ryegrass could be slowed down by a single defoliation, and even more by a second a week later. He found also that defoliation reduced length and median width of the leaves. Mitchell—Coles (1955) found that defoliation of this grass when grown in full light, checked tillering a little but drastically reduced the quantity of tissue formed by individual tillers, largely through reduction in the size of the leaves that had formed. This effect persisted for several weeks after defoliation had ceased. Experiments on Bluegrass *(Poa pratensis)* by GRABER (1931), indicated that reduction of dry matter caused by cutting was due to reduction in the photosynthetic organs of the plant. He concluded that cutting which reduced food reserves tended to retard the subterranean growth which might lower the absorption capacity of the plants. The root growth of *Lolium perenne* and *Phleum pratense* was shown by ROBERTS—HUNT (1936) to be checked by all types of cutting. They found that the amount of check of root growth depended on the severity of cutting. Moreover, WEINMANN (1943) reported that frequent defoliation resulted in a permanent injury to the vigour and power of regeneration of the plants, which was not checked by fertilizer treatment. He also indicated that damage done to the plant by frequent defoliation was associated with corresponding reduction in the root weights and depletion of root reserves. The same author found that fertilizer treatment was not able to counteract the damage to root development and the exhaustion of root reserves.

The present investigation has been initiated to evaluate the effect of cutting on the growth of Westerwolds ryegrass when grown under field conditions. It is hoped that this study will enclose some facts that might be a basis for further studies dealing with interseeding this grass with Egyptian clover.

Materials and Methods

The present work was carried out at the end of November 1962 at the experimental farm of the Faculty of Agriculture, Giza, U. A. R.

Seeds of commercial Westerwolds ryegrass (*Lolium multiflorum* var. *westerwoldicum* Lam.) were used. Six plots, each measuring 6 × 7 meters were planted at the rate of 24 lb./feddan. The experiment consisted of two treatments, cut and not cut. On December 30, 1962 a normal fertilizer of sodium nitrate (16 per cent N), and calcium superphosphate (16 per cent P_2O_5) was broadcast in the experimental plots at the rate of 200 : 100 kg/feddan, respectively. Irrigation was used at intervals between 12—15 days. Other cultural practices were carried out in the usual way prevailing in the region. From 13th January till 3rd of March 1963 (the cutting date), samples of 10 plants were taken out at random weekly from each of the six plots. On the cutting date, when the plants reached a height of about 80 cm, three plots were cut to three inches. On March 10, 1963, a week after cutting, samples of 30 plants were taken weekly from each treatment till the end of the experiment.

In each sampling date, plant height, tiller number, leaf number and leaf area $\left(\frac{\text{width} \times \text{length of blade}}{2}\right)$ per plant were determined and the data obtained were statistically analyzed.

Results

A. Plant height. Results concerning the effect of cutting on the average height of the plants are given in Table 1.

It is clear from the data obtained that the height of the uncut plants increased steadily till it reached 118.0 cm on April 7, 1963. On this date the plants were in their booting stage. From this date onwards, no considerable changes in plant height were recorded till the end of the experiment.

After cutting to 3 inches on March 3, 1963, plant height started to increase slowly till it reached 37.3 cm against 103.6 cm in the uncut plants on March 31, 1963. Thereafter, height showed a slight decrease of 6.9 cm in the next sample, followed by a gradual increase, except on May 12, 1963 where it declined slightly till it reached 50.2 cm in the last sampling date; nearly half as much of that of the uncut plants.

Differences in plant height between the uncut and the cut plants in the successive sampling dates were statistically highly significant.

Booting in the cut treatment which occurred a week later seemed to have no effect on the plant height as the latter continued to increase till the last sampling date of the experiment. Flowering in the cut treatment was very week when compared with that of the uncut plant.

B. Number of tillers. Table 1 shows the effect of cutting on the average number of tillers per plant.

The general trend indicated that the uncut plant increased in tiller number till it reached maximum values of about 7.5 tillers per plant in the sampling dates of March 17 and 24, 1963. This was followed by a sharp decline in the next sampling date (March 31) where average tiller number was 2.5. This decline may be attributed to high temperature prevailing during this period. This sharp decline was then followed by a rapid increase reaching another peak of 5.6 on March 21 which was the start of flowering. Thereafter, tiller number dropped to 0.8 on March 5 and then stood without considerable change till the end of the experiment.

Cutting reduced tiller number a week after its application. Values in March were 7.2 and 3.1 for the uncut and cut plants, respectively. Cut plants then recovered in the following sampling date (March 17, 1963) to reach a maximum of about 4 tillers per plant; nearly half as much as that of the uncut plants (7.5) on the same sampling date. The cut plants then generally declined till the end of the experiment (0.6 tiller per plant). These results are in accord with those obtained by JONES—JONES (1930), MITCHELL (1954), and MITCHELL—COLES (1955).

Statistical analysis showed that differences in number of tillers between the two treatments were highly significant on March 10, 17, and 24 and April 21 (flowering date). On the other hand, no significant response was obtained from the cutting treatment on 31 March and the last four sampling dates.

C. Number of expanded leaves. The effect of cutting on the average number of expanded leaves per plant is given in Table 1.

Table 1

Effect of cutting on the average plant height (cm), number of tillers, number of expanded leaves, and leaf area (sq.cm) of Westerwolds ryegrass plant on the successive sampling dates

No.	Sampling dates	Plant height (cm)		Number of tillers/plant		No. of expanded leaves/plant		Leaf area sq.cm/plant	
		uncut	cut	uncut	cut	uncut	cut	uncut	cut
1	13/1/63	30.8	—	2.4	—	10.5	—	30.2	—
2	20/1	43.9	—	3.7	—	12.8	—	62.5	—
3	27/1	47.8	—	3.2	—	10.1	—	62.7	—
4	3/2	57.2	—	3.7	—	11.3	—	109.8	—
5	10/2	54.8	—	4.7	—	12.3	—	104.0	—
6	17/2	59.5	—	3.7	—	10.2	—	90.6	—
7	24/2	67.1	—	7.1	—	20.6	—	264.7	—
8	3/3	84.6	—	6.2	—	21.9	—	351.1	—
9	10/3	92.0	22.0**	7.2	3.1**	22.4	2.5**	355.7	22.7**
10	17/3	95.6	25.9**	7.5	3.9**	21.4	6.3	358.4	56.0**
11	24/3	97.0	36.0**	7.4	3.1**	15.2	5.7	228.1	73.2
12	31/3	103.6	37.3**	2.5	2.5	10.3	8.9	176.0	54.4*
13	7/4	118.0	30.4**	4.2	2.7*	16.5	7.4	217.4	49.4*
14	14/4	117.3	37.3**	4.7	1.8*	17.0	5.8	224.0	31.6*
15	21/4	116.9	41.3**	5.6	1.1**	21.2	6.1*	327.9	29.1**
16	28.4	116.5	45.8**	1.9	1.0	9.8	6.3	104.5	31.9
17	5/5	124.1	47.5**	0.8	0.6	6.4	5.4	64.2	20.3
18	12/5	108.1	44.8**	1.1	0.9	5.4	4.2	46.1	10.9
19	19/5	116.9	50.2**	0.8	0.6	0.0	0.0	00.0	00.0

* significant at the 5% level of probability
** significant at the 1% level of probability

Number of expanded leaves of the uncut plants showed a trend similar to that given by tiller number. The maximum value obtained on the 10th of March, 1963 was about 22 leaves per plant. Number of leaves was then declined to about 10 on March 31, corresponding with the same decline occurred in tiller number by this date. This decline was followed by an increase in leaf number reaching another peak of 17 leaves per plant on April 14 and thus corresponding with similar increase in tiller number. A drop was then recorded as leaves started to die out.

Cutting significantly reduced the average number of expanded leaves per plant. Value on March 10 (a week after cutting) was 2.5 for the cut plants against 22.4 for the uncut plants. The former then increased reaching a maximum of 8.9 at the end of March. From this date onwards number of expanded leaves of the uncut plants declined giving on the flowering date a value of 6.1

against 21.1 for the uncut plant; this difference was statistically significant. Thereafter, the number in both treatments showed similar values where they declined till the end of the experiment as leaves died out.

D. Leaf area. The leaf area of the uncut plant showed a trend similar to that obtained by the number of leaves of the same plant (Table 1). The maximum leaf area (3.58 sq.dec./plant) was recorded on 17 March 1963, followed by a sharp decline reaching 1.76 at the end of March. Leaf area then increased to reach another peak of 3.28 sq.dec. on 21 April which was followed by a sudden drop till the end of the experiment.

The leaf area of the uncut plants was significantly reduced by cutting (Table 1). Value was 0.22 sq. dec.per plant on 10 March 1963 against 3.55 for the uncut plant. The leaf area of the cut plant then increased reaching a maximum of 0.73 sq.dec. on March 24; nearly one third as much as that given by the non-treated plant on the same date. From this date onwards the leaf area showed a continuous reduction till it reached zero on the last sampling date of the experiment where leaves were readily died out.

Similar results were obtained by MITCHELL (1954), and MITCHELL—COLES (1955), who found that defoliation of *Lolium multiflorum* plants drastically reduced the quantity of tissue formed by individual tillers, largely through reduction in the size of the leaves that had formed. They concluded that this effect persisted for several weeks after defoliation ceased.

Differences in leaf areas between the uncut and cut plants, except in the last four sampling dates were statistically significant.

The insignificant effect of cutting on number of leaves obtained in the sampling dates before flowering coincided with a significant reduction in leaf area in the same period. This might be due to cutting which stimulated the production of new leaves with smaller leaf areas in comparison with those given by the uncut plants.

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EFFECT OF CALCIUM AND SULPHUR DEFICIENCIES ON THE DNA AND RNA LEVELS IN DIFFERENT PARTS OF LINUM USITATISSIMUM L.

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Effect of calcium and sulphur deficiencies on DNA and RNA levels in various parts of *L. usitatissimum* was studied. Plants were grown in acid leached silica sand. Both DNA and RNA decreased under calcium and sulphur deficient plants.

Introduction

Since long a number of workers have endeavoured to study the effects of mineral deficiencies in the plants, but their studies have mainly been confined to the morphological changes induced therein. Only few have tried to analyse the plant constituents, as affected by mineral deficiencies resulting in the drastic alteration of the normal metabolism in plant. A very scant report is available on the effect of calcium and sulphur deficiencies on the DNA and RNA levels in plants. The present investigation is an attempt to study the deficiency effects of these two important minerals on the metabolism of DNA and RNA levels in different parts of *L. usitatissimum* plant.

Material and Methods

For the present investigation *Linum usitatissimum* L. var. NP $(RR)_5$ was chosen. Pure seeds were obtained from I.A.R.I, New Delhi. The seeds were first grown in saw-dust and after fifteen days of growth, the seedlings were transferred in enamel pots containing acid washed silica sand. The culture solution was supplied as recommended by Arnon—Hoagland (1940). Calcium and sulphur deficiencies were created by replacing $Ca(NO_3)_2$ and $MgSO_4 \cdot 7\,H_2O$ with equal amount of $NaNO_3$ and $MgCl_2$, respectively. A slightly modified micronutrient was supplied to sulphur deficient plants where $CuSO_4 \cdot 5\,H_2O$ and $ZnSO_4 \cdot 7\,H_2O$ were replaced by equal amounts of $CuCl_2$ and $ZnCl_2$, respectively. $FeSO_4$ and tartaric acid solution was replaced by ferrous oxalate solution. Samples of two stages, i.e. those of pre-flowering and of post flowering, were analysed. Nucleic acids were extracted by cold and hot perchloric acid method as suggested by Ogur—Rosen (1950).

The DNA and RNA were then estimated spectrophotometrically by noting the optical density at 260 mμ. However, the quantitative values for RNA were obtained by plotting the optical density and extrapolating the values from a predetermined calibration curve obtained for synthetic RNA (NBCO) preparations.

Results

The changes due to calcium and sulphur deficiencies in nucleic acids in different parts of *L. usitatissimum* have been recorded in Table 1.

Table 1

Nucleic acid level in L. usitatissimum under calcium and sulphur deficiencies

Treatments	DNA optical density/gm fresh wt.					
	First harvest			Second harvest		
	Root	Shoot	Leaf	Root	Shoot	Leaf
Control	0.30	0.56	0.72	0.36	0.74	0.80
Ca deficiency	0.22	0.42	0.46	0.32	0.34	0.76
S deficiency	0.14	0.14	0.04	0.31	0.45	0.38

Treatments	RNA in μg/gm fresh wt.					
	First harvest			Second harvest		
	Root	Shoot	Leaf	Root	Shoot	Leaf
Control	1110	1060	1460	1210	1180	2250
Ca deficiency	1100	750	1030	1170	820	1180
S deficiency	920	550	1310	1100	1150	1700

It was observed that RNA content under both deficient conditions had decreased in comparison to controls. Maximum amount was observed in leaf followed by root and shoot in all the cases. With advancing age it was observed to have increased.

DNA level was also found to have decreased in mineral deficient plants as compared to controls. Maximum level was recorded in leaves followed by shoot and roots in control and minus calcium plants at both harvests. However, DNA level was noticed — under sulphur deficiency condition — to be equal in root and shoot but least in the leaf at the first harvest whereas at the second harvest maximum level was noticed in shoot followed by leaf and root. With advancing age it was observed to have generally increased except minus calcium shoot at the second harvest.

Discussion

It is evident from the Table 1 that the equilibrium of the nucleic acids was disturbed under the deficiency conditions. Strong circumstantial evidence can be derived from the remarkable work of Hyde—Paliwal (1958) to support the findings. These workers demonstrated in *Plantago ovata*, that the chromosomal morphology was indubitably affected, when the conventional chelating agent versene (EDTA) was used to keep in harness the divalent cations. It can, therefore, be inferred, that the divalent cations serve a critical function by maintaining the morphology of chromosomes and ensure the normal turnover and systematic distribution of deoxyribonucleic acid (DNA) in the dividing cells, thus controlling the overall process of growth. The present findings reveal, that under the calcium deficiency the turnover of DNA was reduced both in the first as well as in the second harvest.

Hyde—Paliwal (1959) using Barrnett—Seligman (1954) reaction (—SH reactions) established beyond any reasonable doubt, that the nucleic acid (DNA) is intimately associated with either histone to yield nucleohistone (Freese 1958, Ambrose 1956) or with protamine to yield nucleoprotamine. The latter finding is also confirmed by the epoch making endeavours of Felix (1959) on salmon sperms. It is, therefore, within the span of conjecture to postulate, that the integrity of the normal chromosomes might be influenced in the absence of sulphur and a decreased and altered turnover of DNA can be conjectured under the deficiency conditions involving this element. A glance at the table would reveal that a decreased turnover of DNA is obvious in every part of the affected plants, when exposed to deficiency conditions by excluding sulphur from the medium. It has already been argued that —SH groupings imparting solidarity are, in fact, the very backbone of protein structure by their contributions to form —S—S— linkages.

Ribonucleic acid (RNA) has exhibited a decrease concomitant with that of DNA, an inference which vindicates the time honoured statement that the synthesis of RNA is directly controlled by DNA (Hämmerling 1953, Hershy—Chase 1955, Gale—Folks 1956, Brachet 1957). Bonner (1959), debating this problem at length on the basis of trail blazing findings of Ts'O—Sato (1959), and Jagendorf—Wildman (1954), was tempted to hazard the explanation, that the synthesis of RNA hinged, in the ultimate analysis, upon the rhythmic and perfect metabolism of DNA. He further states, that "the contrary microsomes now appear to be synthesized *de novo* in the nucleus . . . From such nuclei particles identical with cytoplasmic microsomes in sedimentation constant, RNA content and the base ratio of RNA have been prepared". Microsomes appear to be the engines of protein synthesis and RNA to be the agency by which the information contained in the DNA of the nucleus is transmitted to and utilized in the synthesis of soluble cytoplasmic enzymes (Tsugita—Fraenkel-Conrat—Nirenberg—Mathaei 1962, Nirenberg—Mathaei 1961).

A glance at Table 1 will reveal that RNA has manifested a distinct decrease under the conditions of deficiency at both harvests. A lowered protein synthesis as evidenced by the present findings is in accord with the decreased RNA turnover, which reflecting upon the growth processes and the smaller size of the affected plants (under calcium and sulphur deficiencies) as compared to their controls can be extrapolated back to the deficient synthesis of nucleic acids.

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VARIA

"KORAI VAJ" DWARF BEAN

("Korai vaj" bokorbab)

Taxonomic place: *Phaseolus vulgaris* L. ssp. *vulgaris* var. *nanus* Aschers. (MANSFELD 1962).

Origin: crossing of Gödöllői × Helia.

Beginning of breeding: 1952, Budatétény.

Breeders: Kálmán Csatári-Szüts and Ágnes Baranyai. Research Institute for Horticulture, Budapest.

State qualification: Preliminary certified improved variety, 1961 (KAPÁS *et al.* 1965).

General characterization: earliest ripening, high yielding dwarf bean with pods wax-yellow when ripe (KAPÁS *et al.* 1965). Resistant variety with low requirements.

Morphological description:

Root system: finely developed tap root system.

Shoot system: of medium height, solid stem and slender habit.

Stem: of medium green colour, with internodes of medium length. Leaf blade yellowish green. Stem slightly hairy.

Foliage: moderately dense with light green, slightly hairy leaves. Top leaflet triangular, of medium size; leaf apex sharp.

Flowers: large, corolla white.

Fruit: very long, straight, with a slight curve, of wax-yellow colour, free of membrane and fibre. Pod weight at harvest ranges from 3.1 and 3.9 g. Cross section of pods cylindric.

Seed: of medium size, oblong egg-shaped or slightly kidney-shaped, white.

Biological characters:

Germination: at 14—15°C it germinates well.

Vegetation period: from emerging to flowering 30—33 days. Early ripening (KAPÁS *et al.* 1965).

Water requirement: not particular.

Resistance to diseases: it is not susceptible to any disease, what is more, resistant to viruses.

Farm technology requirements:

Sowing: early in May, at a row distance of 40 cm and plant distance of 5—6 cm.

Soil: has no particular requirement of soil; in soils of good water supply it can be grown anywhere in the country.

Productivity: very high yielding variety. Amount of yield ranges between 38 and 81 q/cad. hold. Equally suitable for marketing and processing. Its total processing value is 91 (the best 100), colour value 14 (the best 15), flavour value 28 (the best 30) (GÁBRIEL 1963).

Region of cultivation: successfully grown everywhere in Hungary (KAPÁS *et al.* 1965).

GY. MÁNDY

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NATURAL INFECTION OF RAPE WITH CUCUMBER MOSAIC VIRUS IN HUNGARY

Susceptibility of rape (*Brassica napus* L.) to plant viruses [turnip mosaic virus (CLAYTON 1930), cabbage ring necrosis virus (LARSON—WALKER 1941), cauliflower mosaic virus (TOMPKINS 1934, SMITH 1935), rape savoy virus (LING—YANG 1940), turnip yellow mosaic virus (BROADBENT—HEATHCOTE 1948), anemone mosaic virus (HOLLINGS 1957), cucumber mosaic virus (POUND—WALKER 1948, SEMAL 1958 and others)] has been described in several papers.

During the spring of 1967 viruslike symptoms of rape, not reported in Hungary so far, were observed in Herceghalom, near Budapest. The rape plants showed vein clearing, vein banding, severe mosaic, leaf- and pod formations and stunting.

A virus was transmitted from the leaves of rape by grinding the tissues in M/15 phosphate buffer at pH 7, and inoculating to several test plants. Abrasive, 500 mesh carborundum was dusted on leaves before inoculations. Leaves were rinsed with a spray of water immediately after inoculation.

Local symptoms obtained in the greenhouse were as follows: *Tetragonia expansa* Murr., *Amaranthus tricolor* L., *Chenopodium amaranticolor* Coste et Reyn., *Ch. ambrosioides* L., *Ch. capitatum* L., *Ch. giganteum* Don., *Ch. hybridum* L., *Ch. murale* L., *Ch. quinoa* Willd., *Phaseolus lunatus* L. (Fig. 1). Systemic symptoms were apparent in *Spinacia oleracea* L. cv.

Matador, *Capsella bursa-pastoris* (L.) Medik., *Brassica napus* L., *B. pekinensis* Rupr., *Ocimum basilicum* L., *Datura stramonium* L., *Nicotiana glutinosa* L., *N. rustica* L., *N. tabacum* L. cv. Hicks Fixed A2-426, *N. tabacum* L. cv. Samsun, *N. tabacum* L. cv. White Burley (Fig. 1). Local and systemic symptoms expressed were as follows: *Chenopodium botrys* L., *Ch. foetidum* Schrad., *Cucumis sativus* L. and *Capsicum annuum* L.

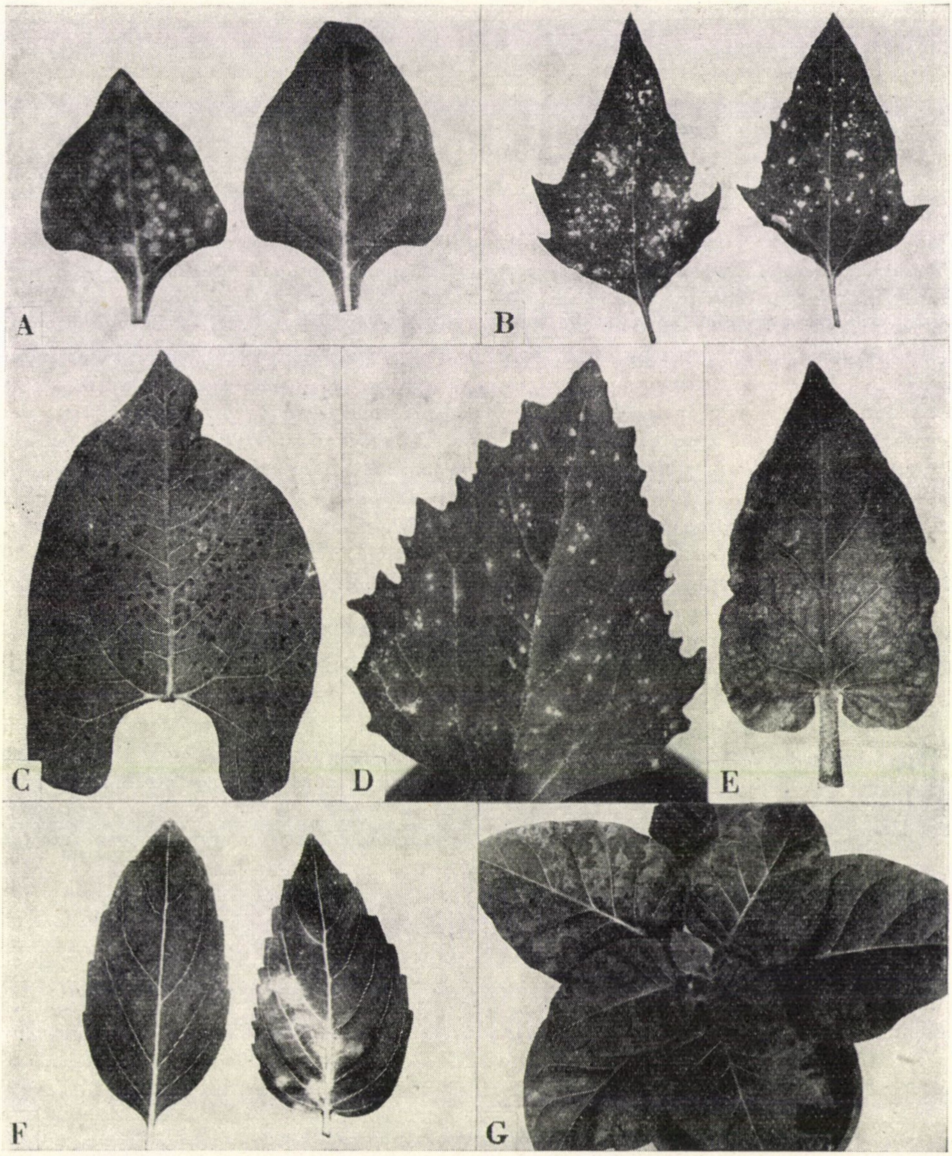

Fig. 1. Local and systemic symptoms produced by the R-isolate of cucumber mosaic virus. A, B, C and D: local symptoms; E, F and G: systemic symptoms. A: *Tetragonia expansa* Murr., B: *Chenopodium giganteum* Don., C: *Phaseolus lunatus* L., D: *Chenopodium murale* L., E: *Nicotiana glutinosa* L., F: *Ocimum basilicum* L. and G: *Nicotiana tabacum* L. cv. Samsun

Aphid transmissions were performed by using adults of the green peach aphids (*Myzus persicae* Sulz.) as vectors and *Nicotiana tabacum* L. cv. Samsun seedlings as test plants. Usually 20 to 25 aphids were subjected to a starvation period of four hours and a feeding period of 8—10 minutes and put on the test plants under glass covers for infection feeding. *Myzus persicae* Sulz. was used to transmit the virus from infected Samsun tobacco to young Samsun tobacco plants. Successful transmission of virus was obtained with *Myzus persicae* Sulz. which infected 37 of the 45 test plants. The first symptoms could be noticed 8—10 days after transmission.

The virus was not transmitted from the seed of rape plants infected with virus.

Physical properties of the virus determined by using expressed sap of locally infected tissue of *Tetragonia expansa* Murr. and systemically infected tissue of *Nicotiana tabacum* L. cv. Samsun are as follows: thermal inactivation, 60—62° C in 10 minutes; dilution end-point, 2×10^{-4}—10^{-4}; longevity in vitro, 6—9 days at room temperature; storage over $CaCl_2$, over 157 days.

Similar tissues were used in serological experiments and electron microscope studies. Serological studies indicated that the virus systemic in *Nicotiana tabacum* L. cv. Samsun was strongly related to cucumber mosaic virus (CMV), but not to tobacco mosaic virus (TMV), potato virus Y (PVY), potato virus X (PVX), (Horváth 1969).

In collaboration with Dr. H. B. Schmidt (Institute of Phytopathology, Aschersleben, Germany) electron microscopic preparations, obtained by the dip method (cf. Brandes 1957), were made. No specific particles could be found in extracts prepared in several ways from plants (*Nicotiana tabacum* L. cv. Samsun, *Chenopodium quinoa* Willd., *Tetragonia expansa* Murr.) infected with virus, when these preparations were examined with an Elmi D electron microscope.

In cross protection tests Samsun tobacco plants were infected with a virus isolate (from rape, R) and superinoculated with the white strain of CMV. The white strain of CMV (CMV-W) was kindly supplied by Dr. K. Schmelzer (Institute of Phytopathology, Aschersleben, Germany). The experiments have shown that the R isolate protected the tobacco plants against infection with CMV-W. No protection was observed when *Nicotiana tabacum* L. cv. Samsun plants inoculated with CMV-W as protecting virus were inoculated with the R-isolate as a challenge virus.

From investigations on the host range, properties, aphid transmission with *Myzus persicae* Sulz., serology and electron microscopy and from the results of cross protection tests, the R-isolate (designated by us as CMV-R) could be identified as a new strain in Hungary of CMV).

This report is believed to constitute the first record from Hungary of natural infection of rape by CMV.

Acknowledgements

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THE FIRST HUNGARIAN REVIEWER OF THE LINNEAN SYSTEM

József Benkő (1740—1814), one of the pioneers in Hungarian botanical research work, belongs to those men of talent whose real importance is not reflected in their life-work still being in existence; i.e. not in what has been realized of their plans but in what they could have been able to achieve; what has been in them as potential energy which, due to the given circumstances, could not be carried into effect.

He was appreciated by his biographers rather as a historian since in this field there have remained more traces of his activities, — while of his botanical works there are not many in existence any more. However, it was he who first summarized the system of Linnaeus in Hungarian language when making a funeral speech: "Téli bokréta . . ." (Winter nosegay . . .) in 1777.[1]

At the first hearing this may sound strange; the explanation becomes evident however, when we recall the characteristic features of that period. This was the age of enlightenment the spiritual trends of which have reached, relatively soon, our country, too. The intermediators were mainly the protestant students studying at West-European universities; it was here that, besides their theological studies, they got acquainted with the new trends of philosophy and also with the latest results of natural sciences thus putting our country in touch with Europe's intellectual life. In many cases this happened simply through a passive take-over of new kinds of knowledge translating them into Hungarian; in some cases, however, there were active contributions too, thus reacting to European culture.

In Hungary also, the ideas of enlightenment made their effects felt in preaching. When reading the preaching literature of that epoch, it can be established that dogma and polemics were thrust into the background while morals, the propagation of useful and practical knowledge, the popularization and elucidation of new scientific discoveries and theories came into prominence. All this met the immanentism and the utilitaristic attitude of that epoch. The talented protestant clergyman of manifold interest, József Benkő was also a son of his century in every respect. He was born on the 20th of December, 1740 in Bardóc (Transylvania). His father Mihály Benkő was also a protestant clergyman. Though he had 12 children, he made all of them carry on studies. Benkő attended schools at Nagybacon, Udvarhely and

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[1] Gombocz, E. (1936): A magyar botanika története (The history of Hungarian botany). Budapest.

Nagyenyed. As early as in his school-years, he took great interest in botany, collecting plants and instructing himself autodidactically. Viz., regular teaching of botany was not yet taken up in the schedule of schools. It was only at the time of its being reorganized in 1770 that the Nagyszombat University got medical faculty and a botanical chair; at the philosophical faculty it was only in 1774 that the Empress Maria Theresia established the regular teaching of natural history which was introduced, by the Ratio Educationis, to secondary schools, too (1777). On this Benkő writes as follows (1775): "In our happy century devoted to sciences, when the laws of Nature's plant-domain are keenly studied in all parts of Europe, it is only in our Transylvania where, except a few scientists, we do not even know what is meant by the term: natural history. A situation that is very much to the disadvantage of youth learning at schools."[2] In addition to the above, the so-called plant science and botany were sharply distinguished at both the universities and secondary schools. Botany, as a part of medical sciences, was dealing with medicinal plants and the system of plants. Plant science (natural history), on the other hand, was treating the theoretical part of botany, the character and use of plants. At the faculty of philosophy in the university the professors did not deliver lectures on taxonomy. Thus, those interested in botany, were mainly medical botanists who preferred studying the medical utilization of plants to flora-research. Benkő was not a doctor and though he knew about the healing quality of certain plants, it was not that aspect which led him on his botanical trips but rather the aim to investigate the flora of Transylvania. How it happened that, after all, the theologist Benkő became a botanist, — would be difficult to trace and to find it out. To join merely autodidactically the work by Linnaeus and the literature in the 18th century must have been difficult, indeed. One thing we know for certain: as early as being a student at Enyed, he was a co-worker of Péter Bod who was engaged in the new edition of the Páriz-Pápai dictionary. Later, his previous school-mates returning from abroad, and the botanist doctors of the vicinity might have been those who made him acquainted with modern special literature. Benkő himself has never been to universities abroad though, being a good scholar, he always would have liked to go abroad. In the year 1766 he wrote to the congregation in Középajta that he would not be able to accept the invitation for assistant ministership to his father because he was preparing to go abroad. However, his patron, Count Mihály Teleki, died suddenly and unexpectedly so he accepted the invitation when the same congregation invited him again in 1767. Beginning with that year he acted as pastor in Középajta, and from 1785 on, in the capacity of dean. Besides these activities he diligently went on botanizing and made plant-collecting trips in different parts of Transylvania.

As a botanist he first met general attention when he also submitted a report, on a decree of the Court issued in 1773 concerning the search for drugs. The State Health Commission accepted it with much appreciation and wrote on it as follows: "The report displays his infallible proficiency in both plant-science and related works. Though he prefers the system of Linnaeus to any other system, he knows them also, to such an extent that he would be able to set his work according to any system."[3] Therefore, it was suggested that Benkő should be entrusted with holding lectures on herbs for pharmacists in Nagyszeben and in Brassó. It was also suggested that he would be appointed for professorship at the pharmaceutical chair to be established at the Kolozsvár University. However, due to the indifference of competent people, the envy and intrigue of some of his contemporaries, neither of these plans got realized. Though his disappointment was great, he did not stop working. In the years 1777—78 he managed to have two volumes of his work "Transylvania" published. In it he

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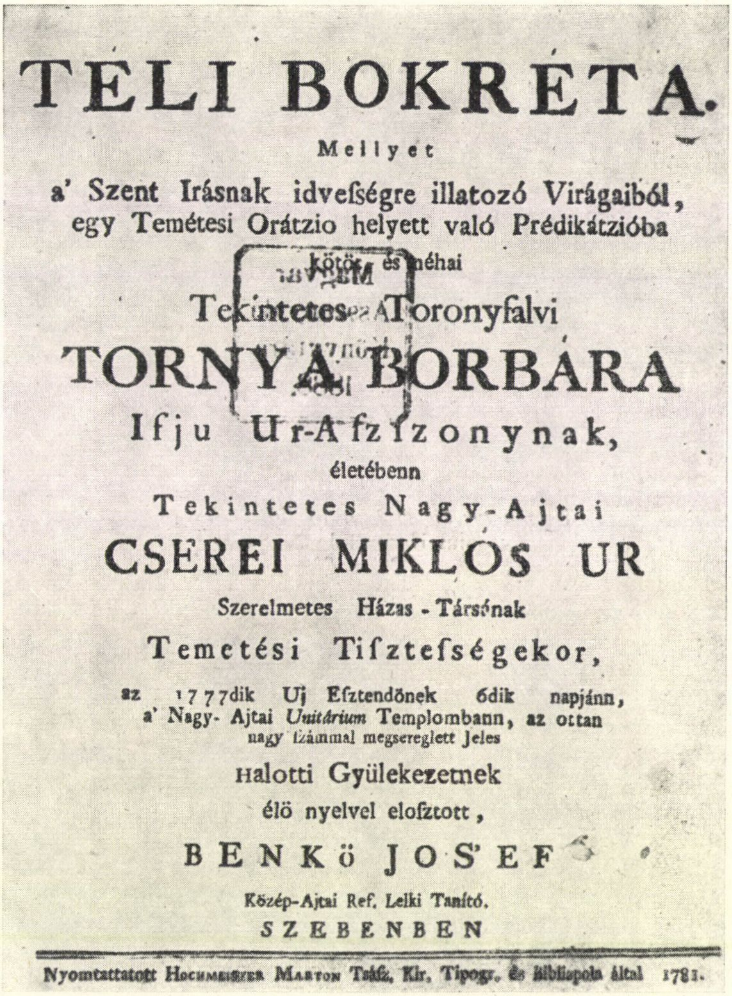
[2] Ernyei, J. (1932): Benkő József természettudományi hagyatéka (J. Benkő's natural scientific remains). Pécs (Klny. Botanikai Közlemények, 1—4, 58). (1932).

[3] Mikó, I. (1867): Benkő József élete és munkái (The life and works of J. Benkő). Pest, p. 38.



TÉLI BOKRÉTA.
Mellyet
a' Szent Irásnak idveſségre illatozó Virágaiból,
egy Temétesi Orátzio helyett való Prédikátzióba
kötött és néhai
Tekintetes Toronyfalvi
TORNYA BORBÁRA
Ifju Ur-Aſzſzonynak,
életébenn
Tekintetes Nagy-Ajtai
CSEREI MIKLÓS UR
Szerelmetes Házas-Társának
Temetési Tiſzteſségekor,
az 1777dik Uj Eſztendönek 6dik napjánn,
a' Nagy-Ajtai *Unitárium* Templombann, az ottan
nagy ſzámmal megsereglett Jeles
Halotti Gyülekezetnek
élö nyelvel eloſztott,
BENKö JOS'EF
Közép-Ajtai Ref. Lelki Tanító.
SZEBENBEN

Nyomtattatott Hochmeister Marton Tsáſz. Kir. Tipogr. és Bibliopola által 1781.

describes the history and natural conditions of Transylvania. The publication of this work brought his name into repute and his scientific fame became known not only in this country but abroad, too. In 1781 he was elected a member of the Haarlem Scientific Society and the Society made his work on the famous caves of Transylvania translated into Dutch.[4] In 1781 appeared his work on ecclesiastical history under the title "Milkovia" as well as his funeral oration "Téli bokréta . . ." (Winter Nosegay). The paper Magyar Hirmondó (Hungarian Review) wrote about the latter as follows: "In Nagyszeben, under the title 'Téli Bokréta' a Botanical Preaching was printed that had been said by the Rev. József Benkő as a funeral oration."[5] As mentioned previously, at that time it was not very seldom that preachings contained also natural scientific, practical and instructive elements. Besides, orations in

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[4] Imago specuum M. Principatus Transsilvaniae admirandorum huiusque plurima ex parte incognitorum. Harlem, 1774, or 1781. (No copy of it has been found.)

[5] Mikó q.a. (quoted above) p. 72.

general and especially funeral orations were passed by the censor more easily. Quite often did the protestants choose that way of having their shorter works published.[6] In the above special case, maybe, publishing was made easier by the fact that, since the deceased had been a nobleman, at the end of his speech, Benkő made the family-tree of the deceased acquainted with his audience. In that tracing back the family we come across such illustrous names as the Transylvanian reigning princes János Kemény and Gábor Bethlen.[7] Benkő must have reckoned with an intelligent audience who would show interest as well as financial support for the work being published.

The text of the preaching are the verses 40 : 6—8 of Esau: "Each body is like a grass, and all its beauty is like the flower of the meadow . . ." On the basis of this idea he drew a parallel between human and plant life. Pointing to certain physiological similarities, he set up allegories. The main thesis of the second part: "Human beings are similar to grasses and flowers as regards multiplication." At this part he gives the following observation: "For those who have but little knowledge about herbs, however, want to understand my supposition, kindly let me expound, besides what had been said in my preaching, the parts of the Flower in the language of my Nation." "Of the many flowers, look at the white Lily *(Lilium candidum)* so well-known to you, my Clever Reader, and then you will recognize the male and female parts. In it you will discover the six petals *(petala)*, within these take place, in a circle, the six Stamens *(Stamina)* on each of which you can observe the following parts: 1. The Filament *(Filamentum)* being similar to a thread, 2. the Anthers *(Anthera)* which are elongated ball-forms on the top of the filament, 3. the Pollen *(Pollen)* found on the anthers that, if moved by breeze, bee or other insects, will fall off . . . But let us see, in the same Lily, the female organ, too, that makes its appearance in the following way: In the corolla *(Corolla)* among the six stamens, there is another being quite different from those described above and that is called Pistil *(Pistillum)*. This one also has three parts because 1. at its bottom there is a longish, furrowed *(sulcatus)* globular part that might be called Germ *(Germen)*, 2. from it there arises up to the height of the Corolla, a thick, thread-like roundish particle that is called the Style *(Stylus)*. On its top there takes place the three-sided Stigma *(Stigma)* looking like a little button. That three-sided part of the pistil is the female generative organ. It is to be remarked here that in certain flowers there is only one stamen, so they are called monandrous plants (1. *monandra planta*). In another one there are two stamens like e.g. the privet *(Ligustrum vulgare)* . . . and many others which are called diandrous plants (2. *diandria)*. Thus, we speak about three-four-five-six-seven-eight-nine-ten-twelve-twenty- and polyandrous plants according to the number of the stamen, which are called in Latin or rather, in Greek: 3. *triandria*, 4. *tetrandria*, 5. *pentandria*, 6. *hexandria*, 7. *heptandria*, 8. *octandria*, 9. *enneandria*, 10. *decandria*, 11. *dodecandria*, 12. *icosandria*, 13. *polyandria*. That late Professor of Botany *(Botanicus Professor)*, K. Linnaeus being the foremost among all, was the first to categorize the products of the Vegetable World *(Vegetabilis Regni)*, viz., its trees and grasses in systems of the same sex (sexuale systema) and divided them into 24 classes *(Classes)*, i.e. to the above enumerated thirteen and also the following: 14. *didynamia*, 15. *tetradynamia*, 16. *monadelphia*, 17. *diadelphia*, 18. *polyadelphia*, 19. *syngenesia*, 20. *gynandria*, 21. *monoetia*, 22. *dioetia*, 23. *pollygamia*, 24. *cryptogamia*. The Classes were divided by him into Orders *(Ordines)* terming them according to the number of female organs, viz., the flower in which there is only one pistil, is called monogynous plant *(monogynus flos)* as seen in the case of the white Lily, — those having two pistils are termed digyna and, in this way, according to the number of female organs, we speak about trigynia, tetragynia, etc. Further, in every Order there are different genera, within them the species and the variety *(Varietas)*

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[6] The 84 sermons of Péter Nádudvary published in 1741, are nothing but 84 treatises in all fields of theology.

[7] BENKŐ, J. (1781): Téli bokréta . . . (Winter nosegay . . .) Nagyszeben, pp. 47—54.

are involved . . . Those who want to know the science on the union of trees and grasses from more examples and more fundamentally, and if they understand Latin, will find great pleasure in reading among other works of Linnaeus his famous scientific Work: Fundamenta Botanica . . ."[8]

Whether there has been any effect of Benkő's work on the Hungarian literature of botany, cannot be proved. However, if we want to be objective, we have to answer with a definite "no". After all, for those interested in botany and especially if they were able to read Latin, the works of Linnaeus were accessible in the original form; they did not need Benkő's compendious review. The importance of the Téli bokréta (Winter Nosegay) lies rather in the fact that in this faraway corner of Transylvania the system of Linnaeus was translated and explained in Hungarian language while Linnaeus was still living (1777) and, as Benkő himself related it, never has he found such an attentive audience as the mourning people to whom he addressed his words on the science of botany. Benkő's aim was to propagate the new knowledge of natural science, to make it public property. He himself says with his introductory words that his speech was meant "for those who have but little knowledge about herbs".[9]

From the viewpoint of botanical literature, it is rather the language of the "Téli bokréta" that is of importance. The fact that Benkő invented those Hungarian expressions with which he interpreted the system of Linnaeus. Laudable is his initiative because while the binominal nomenclature and the systema sexuale found their way to Hungarian scientific circles but slowly, — a good example of which can be considered Grossinger's Dendrology (1799) enumerating all plants without any system, mostly by names known before Linnaeus,[10] — Benkő expounded the system of Linnaeus in Hungarian language as early as 1777, and in his work Transylvania he describes the Transylvanian plants by binominal nomenclature.

Benkő meant the Flora Transsilvanica to become his chef-d'oeuvre. In this he wanted to describe the plants of Transylvania ". . . according to the system of Linnaeus modified by Scopoli", mentioning also their site, their medical and economical uses. This he planned to complete with a botanical dictionary in Latin—German—Hungarian languages together with the required examples and sketches. In 1784 he applied to Joseph II. for being assisted in having his work published. Alas, in vain. What became of the manuscript, has remained in obscurity. The original copy got probably to the Nagyenyed library where it might have perished in the fire of 1849. A duplicate could have got even to Göttingen because it was from there that Sámuel Gyarmathy promised Benkő to intercede on behalf of the publication of the work asking Prof. G. F. Hoffmann in Göttingen to lend a helping hand.

The further stations of his life were the following: professor at the Székelyudvarhely College from 1787 to 1789; then, retiring to his estate in Középajta, he continued his historical work. In 1796 once more he met recognition when getting, from Francisc II., a medal worth 20 gold coins for his merit in acclimatizing the *Rhus coriaira* L. (or *Rhus typhina* L.). It substituted the leather-tanning material that, so far, had been imported from abroad. So, this meant considerable economical profit. The treatise written on it was his last work published: "The Közép-Ajta sumach or sumac and its use in tanning cordovan leather". From this time on, his career declined more and more. Due to different accusations, he had to resign his ecclesiastical position and his estate also lost. In 1799 he went to his sons and there he lived until his death in 1814.

He gathered medicinal herbs and sold them; he also tended his botanical garden.

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[8] BENKŐ q.a. pp. 12—14.

[9] BENKŐ q.a. p. 12.

[10] GOMBOCZ, E. (1914): Linné és a magyar botanika (Linné and Hungarian botany). Az O. N. E. Veres Pálné Leányiskolájának értesítője az 1913—1914. iskolai évről (Report of the Veres Pálné secondary school for girls on the year 1913—1914). Budapest, p. 21.

Not much has remained of the results of his activities; many of his works were not published, sometimes even the manuscripts got lost. However, it cannot be denied that József Benkő can be appreciated, as one of the illustrous and, in certain respects, pioneer scientists of Hungarian botany. Not having other possibilities, he availed himself of a funeral oration in order to propagate the botanical knowledge that he had always found so very important.

V. I. HANEKAMP—KOVÁCS SEBESTÉNY

POLARIZATION OPTICAL EXAMINATION OF THE SUBMICROSCOPIC STRUCTURE IN THE CELL-WALL ON DIFFERENTIATING EPIDERMIS CELLS AND FUNCTIONING STOMATA

The epidermis of foliage leaves is a tissue system built up of most divergent cell types and being sometimes rather complicated. The main characteristics of its structure show close correlation — both from physiological and oecological viewpoints — with the functions that appear primarily in the regulation of gas-exchange and in the protection against exterior nfluences (LINSBAUER 1930). Of the different cell-types in the epidermis, besides the anatomical peculiarity, the fine structure of the cell-wall is also characteristic. In the course of the increase and differentiation of the cells the submicroscopic structure of the cell-wall develops genetically determined in such a manner that the architectural peculiarities belonging to the submicroscopic dimension will also be in close correlation with the special function of the cell in question (FREY-WYSSLING 1959, ROELOFSEN 1959, ZIEGENSPECK 1941). In the case of the epidermis this reveals itself especially in the formation of the stomata (ZIEGENSPECK 1942, CZAJA 1961—62).

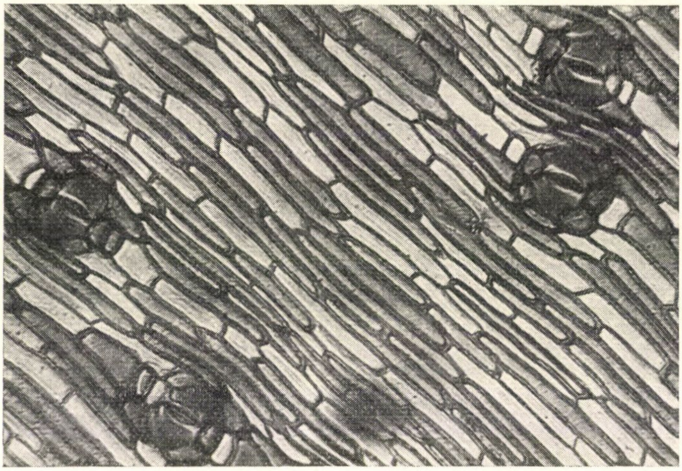

Fig. 1. Part of the epidermis of *Pandanus sanderi* Mast. from the reverse of the foliage leaf (Approx. 600 ×)

In our investigations carried out with qualitative and quantitative polarization microscope method, there has been partly examined the wall-structure of cells of different types, in the epidermis of the foliage leaf of *Pandanus sanderi* Mast. also in connection with the development of the leaf, — partly we have evinced at the closing cells of *Chrysanthemum* *maximum* D.C. and at the neighbouring cells, respectively the divergencies appearing in the fine structure of cell-wall being related to the opening and closing of the stoma. The birefringence of the epidermis cell-walls in the above-mentioned species is stronger than the average, therefore, they are extremely suitable for polarization optical observations. In order to remove and clean the epidermis, the leaves had been previously kept in trietanolamine at 90° C for 12—24 hours. For the identification of substances forming the cell-walls reaction or staining, was in some cases carried out with Cl Zn J, Congo-red, benzoazurin and vezuvin-malachite-green. In the examinations Zeiss-manufactured "Polmi A" polarization microscope was made use of; by Red I plate was established the birefringence character while the measurements were made with Sénarmont compensator.

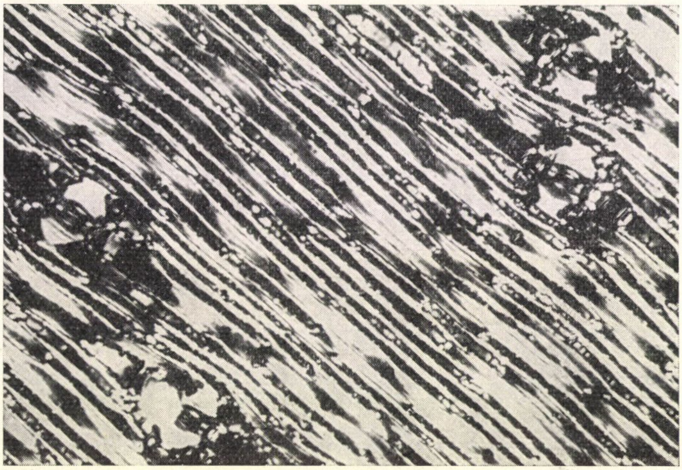

Fig. 2. Part of the epidermis of *Pandanus sanderi* Mast. in polarization microscope between crossed nicols. (Approx. 600 ×)

On the reverse of the leaf of *Pandanus sanderi* Mast. the tissue system of the skin is built up with 5 kinds of cell types (Fig. 1). Three of them form the stoma apparatus in such a manner that, beside the closing cells, parallel with the stoma, one thin-walled subsidiary cell each takes place, while at the ends of the stoma, isodiametric thick-walled subsidiary cells can be seen. The epidermis cells proper, as concerns their form are similar to one another; they are long-shaped, elongated in the direction of the axis of the leaf. In fact, they are of two kinds. One of them has thin cell walls with even surface, where the cells are living. In the other type the walls are thicker and containing lignine; foveolae are to be found on the walls and when developed, they contain no more cytoplasm. According to our polarization microscopic investigations (Fig. 2) the wall-texture of the cell-types can be characterized as follows: the closing cells are, in fact, optically negative, viz., the microfibrils fall perpendicularly to the longitudinal axis of the cell. Owing to the arched shape of the closing cells, the microfibrils are — after all — arranged radially in the wall of closing cells. This structure agrees with the general principle relating to the stomata and established by ZIEGENSPECK (1942). The thin-walled subsidiary cells proved to be optically positive which points to the microfibrils running down lengthwise. Since the shape of these subsidiary cells is likewise arched, these microfibrils are perpendicularly orientated to the microfibrils of the closing cells. This phenomenon was on other objects described by CZAJA (1961—62) and called as "tangential structure". In the thick-walled subsidiary cells, as related to the longitudinal axis of the leaf, there exists a transversal fibrillation. The epidermis cells, with thin wall proved to be of positive birefringence, thus micellated lengthwise, while the thick-walled ones are of negative birefringence which means that they are transversally micellated. Summarizing the above it can be stated that the epidermis of *Pandanus sanderi* Mast. is alternately built up both in the stoma apparatus and in areas outside them, by such types of cell in the wall of which — related to one another — a microfibril network of perpendicular orientation has developed.

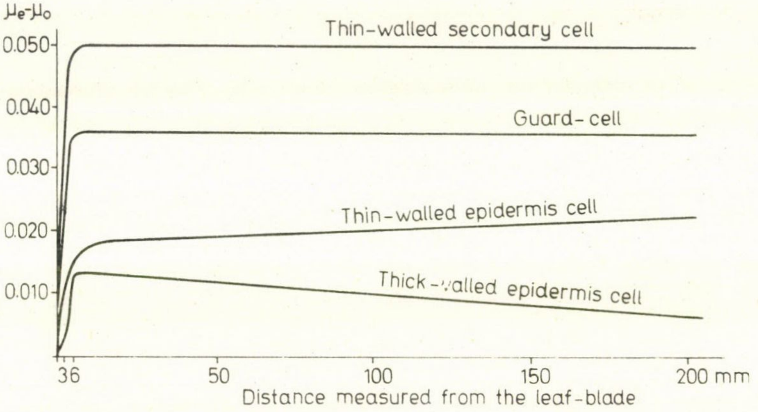

Fig. 3. Change of the birefringence values of the cell-wall in different cell-types of the epidermis of *Pandanus sanderi* Mast., in connection with the development of the leaf

According to the results of quantitative examinations (Fig. 3), the strength of birefringence arising from the relation between the retardation and the thickness of the cell-wall, is the greatest in the subsidiary cells situated parallel with the stoma-axis, while it is the smallest in the thick-walled epidermis cells. This leads us to the conclusion that the arrangement of microfibrils is the highest in the wall of the former cell-type, while it is the least in the latter one. The quantitative study of the epidermis in the developing leaf showed that the microfibrillar network of the cell-walls developed already at an early stage in the leaf-blade zone of one mm or two and subsequently it does not change considerably (Fig. 3). The later gradual decrease in the birefringence of the thick-walled epidermis cells is supposed to be connected with the subsequent lignification.

In the closing cells of *Chrysanthemum maximum* D.C. and in their immediate neighbourhood, the qualitative and quantitative conditions in the submicroscopic structure of cell-walls are sketched in Fig. 4. In the closing cells radial micellatedness can be established (Fig. 5), while in the parts of sursounding epidermis cell-walls adjacent to closing cells, there prevails the above-mentioned tangential structure. It is characteristic of the quantitative conditions that in the wall of the neighbouring epidermis cells where tangential structure can be observed, the retardation is considerably higher (more than the double in the direction of the transversal axis of the stoma) than the retardation measured in the wall of the closing cells. In the course of our experiments including also living epidermis, the birefringence of the same stomata was measured while they were open and also after the treatment with saturated sugar solution, when the stoma had already been closed. After the closing of stoma the values of retardation were changed in the direction of the transversal axis of the stoma: they decreased both in the closing cells and in the neighbouring cells. However, at the ends of closing cells no such change took place. From our observations it can be concluded that

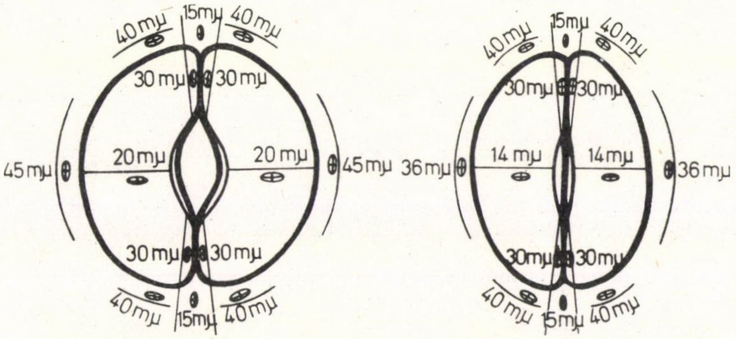

Fig. 4. Retardation measured in the wall of the closing cells and of the neighbouring cells of *Chrysanthemum maximum* D.C., in the open and closed state of the stoma

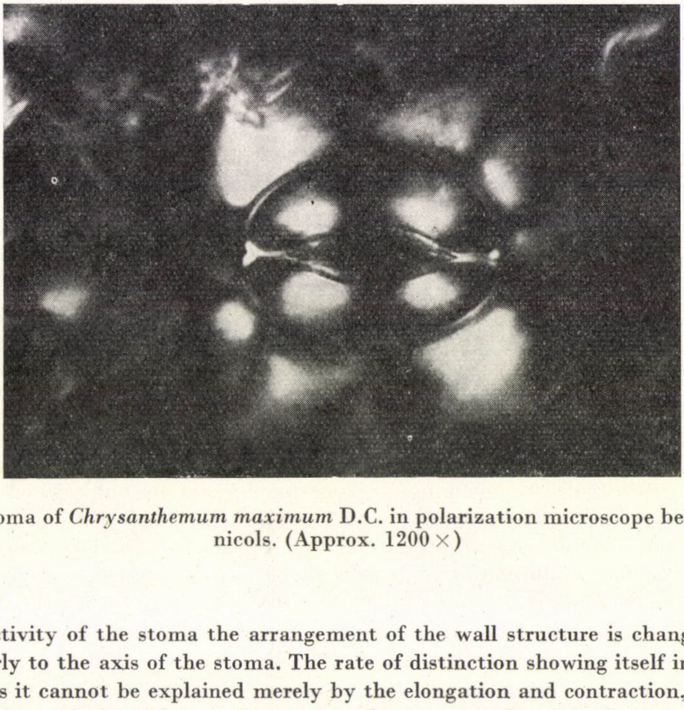

Fig. 5. The stoma of *Chrysanthemum maximum* D.C. in polarization microscope between crossed nicols. (Approx. 1200 ×)

during the activity of the stoma the arrangement of the wall structure is changed especially perpendicularly to the axis of the stoma. The rate of distinction showing itself in the retardation is such as it cannot be explained merely by the elongation and contraction, respectively, of the micelli but only by tighter and consequently, more regular or by looser and thus more irregular state of the microfibril texture. The fact that simultaneously with the opening and closing of the stoma birefringence-changes of similar rate occur also in the wall of the neighbouring epidermis cells, seems to prove that besides the closing cells, the epidermis cells take also part — though indirectly — in the opening and closing motion of the stoma.

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RELATIONSHIP BETWEEN GERMINATION OF GRAIN SORGHUM (SORGHUM VULGARE VAR. FRUMENTACEUM) AND TEMPERATURE OF SOIL

In our days the task of increasing the feed basis and protein production necessary to meet the increased requirements of livestock raising is of an ever growing importance (BAJAY 1961). In Hungary, in addition to the traditional fodder plants, the growing of various sorghum varieties (Sudan grass, sugar- and grain sorghum) for feeding purposes is increasing year by year and becoming more and more important. After recognizing their favourable characteristics an increasing number of farms introduce their growing.

When growing grain sorghum, however, many — both oecological and agrotechnical — problems present themselves. The increasing interest as well as the factors mentioned above make a further detailed examination of the growing conditions necessary in order to determine their numerical value and favourable or unfavourable effects by studying the environmental factors acting during the vegetative period.

When studying the development of grain sorghum and the environmental — primary the meteorological — factors we first examined the relationship between germination and soil temperature.

In Hungary its purposeful introduction was started by SURÁNYI (1926). Germination-oecological conditions of this plant coming from countries of hot and relatively dry climate have been studied by many, however, precise numerical data are scarce. It is mainly the data of exact trials that are lacking in our domestic observations and evaluations, too.

IKRAMOV (1963) studied the oecological conditions of germination near to Taskent. He found the lowest temperature of germination to be 8—12° C. This temperature value — though giving some information — is not enough for more detailed examinations.

Unfortunately, most authors give only the date of sowing. SAMOILA (1955) in Roumania found the first half of May, while RUEBENBAUER—LONC (1964) in Poland the month of June to be the best time for sowing grain sorghum. UMAROV—IKRAMOV (1964) in their experiments conducted in Uzbekistan obtained the best results when sowing between the end of March and the beginning of May. In Hungary, germination conditions of Sudan grass have intensively been studied by KÜKEDI (1965); he found that Sudan grass was best sown at the end of April and early in May.

According to our opinion these investigations have to be further refined by the local conditions taken into consideration, for it is well known, that conjugate effects of the given environmental factors ensure, promote or inhibit germination and — later on — growth. It is of great importance — especially when new crops are introduced — to fix the major phases of agrotechnics (e.g. sowing) — which are but approximately determined by calendar dates — to numerical values obtained by exact studies.

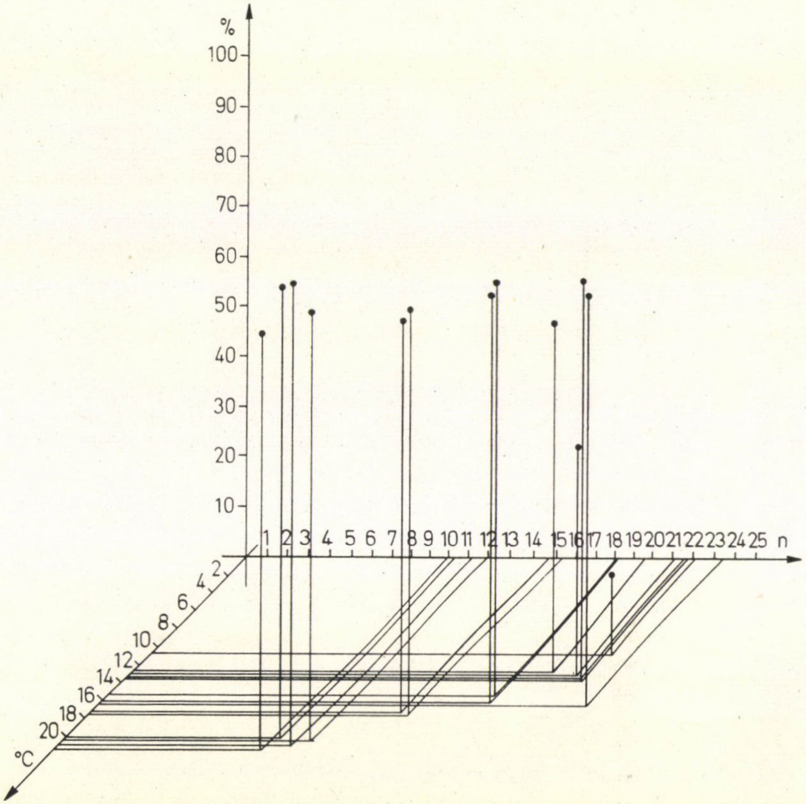

Fig. 1. Time of full germination of the hybrid grain sorghum "NK-222", average daily mean temperature of the period and diagram of percentage germination

We first intended to study the effect of soil temperature, so we kept the moisture content of soil — the other important factor required for the germination of grain sorghum — on a constant level, at the optimum water capacity.

The experiment was carried out in the autumn of 1967, in a soil tunnel of 11.0 × 3.5 m useful area. The 0.2 mm thick, transparent, colourless foil permitted to study germination in a relatively short period at temperatures considerably differing from each other.

In the experiment a total of 100 seeds of the hybrid grain sorghum "NK-222" were sown in four replications of 25 each, every second day at a depth of 3 cm. The distance of the parallel rows was 15 cm with a plant distance of 4 cm.

In each replication the emerged plants were counted every day, and soil temperature was measured at the depth of sowing three times a day — at 7 a.m. and 1 and 7 p.m. Mercurial thermometers were placed in the middle of the plots.

We had obtained a total of 13 evaluable sowing series before the permanent ground frost set in. Mean values of the experiment carried out in four replications are shown in Table I.

In the first column of the Table the average length of the germination period — i.e., the period between sowing and the state of all plants emerged, — in the other columns morning-, noon- and evening values and daily mean values, respectively, of soil temperatures

Table 1

Mean values of the experimental results

Length of time of germination	Average soil temperature during germination				Number of sunshine hours	Percentage germination
	morning	noon	evening	daily mean value		
day	°C	°C	°C	°C	hour	%
10.5	14.4	26.2	20.0	20.2	4.7	89
12.0	14.8	26.0	20.0	20.2	4.7	83
11.5	14.0	26.4	19.6	20.6	4.3	91
10.2	15.5	27.3	20.6	21.1	4.9	82
23.5	12.6	23.2	17.4	17.7	4.2	80
18.7	12.1	24.0	17.5	17.8	5.3	81
18.5	11.0	22.9	16.5	16.8	5.0	82
18.7	10.3	21.6	15.4	15.7	4.6	80
18.5	9.9	20.9	14.7	15.2	4.0	77
22.2	9.4	19.2	13.4	14.0	3.0	78
20.5	12.0	20.2	13.2	13.8	2.2	69
22.0	9.1	17.5	12.6	13.1	2.3	46
22.5	8.0	16.1	11.3	11.8	2.3	15

in the period of germination are presented. In the sixth column daily average sunshine hours of the mentioned period, while in the last column percentage germination are given.

The data of the Table show that in the first 4 replications, when the daily mean temperature at a depth of 3 cm exceeded 20°C 86 per cent of the seed sown germinated and the length of the germination period was 10—12 days.

In the next 4 replications, when the average daily mean temperature of soil ranged from 15° C to 17° C, germination occurred in 75—80 per cent and the period of germination was as long as 18—23 days.

In the other treatments the number of plants emerged has decreased rapidly. In the last — still evaluable — treatment, when the average soil temperature at a depth of 3 cm was as low as 11.8° C, only 15 per cent of the seed sown germinated. At temperatures lower than that germination did not even occur.

According to the data of the experiment 13.8° C and 13.1° C, respectively — i.e. a round 13 degree — average daily mean temperature can be considered as the limit value of the germination of grain sorghum. Under such temperature conditions — with an optimum soil moisture content — about a half of the seed sown germinated, but at lower temperatures germination rapidly decreased or did not even start.

73 per cent of a total of 1300 seeds sown at different times during the experiment has germinated. The average length of the period between sowing and full germination was 17.6 days, the daily average mean temperature at a depth of 3 cm — i.e. at sowing depth — 16.7° C.

After surveying briefly the mean values of the experimental data we can see, that an average daily mean temperature of at least 11.8° C was required for starting the germination of the hybrid grain sorghum "NK-222" examined. At an average daily mean temperature of 15° C 80 per cent of the seed sown germinated, the period of full germination was, however, as long as 18 days.

We can say that at an average daily mean temperature of 20° C the number of plants emerged depended only on the germinative ability of the seed sown. At this temperature full germination required generally 10—12 days. This rather high value must have been caused by increased night and morning chills, respectively.

Our paper is restricted to the presentation of merely the mean values of the experimental results, however, even these data prove that in determining the optimum time of sowing, calendar dates have to be replaced by exact temperature measurements at sowing depth. The different dates are suitable only for the purpose of a general information.

After a more detailed mathematical evaluation of the experimental results, there is — of course — a possibility of determining numerically further relationships and correlations between the different parameters, respectively. We wish to discuss the details and results of our study in our next paper.

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*

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INFLUENCE OF GROWTH-REGULATORS ON THE ROOT ORGANIZATION OF PHASEOLUS COCCINEUS L.

The bipolar emergence of the lateral roots of the bean and ricinus seedlings observed recently (Gracza 1967) has led us to the idea of trying to influence experimentally the differentiation of the primary and the two ends of lateral roots (basipetal and acropetal) by substances stimulating and inhibiting growth. Our objective was, in a more concrete sense, to bring about a typical primary root system by inhibiting the growth of the 2 or 3 lateral root levels i.e. the so-called basipetal lateral roots coming into being under normal conditions on the radicle in the direction of the cotyledons or to exert an inhibiting influence on the development of the main (primary) root and that of the acropetal lateral roots in order to try to stimulate the hypocotyl to a more extensive growth of the root and hereby to form a body-type of rhizoma character.

A great deal of similar experiments of influencing growth have been made concerning the development of the root of woody plants, cuttings and petioles (OPLT—CERNY 1962, HUMPHRIES 1963, VIEITEZ—SESANE *et al.* 1964, BASHIN 1966, FRIES 1960, TILIO 1967) and some initial results obtained in connection with the organization of the lateral roots of the *Phaseolus mugo* (LATORAYA—RAY 1963).

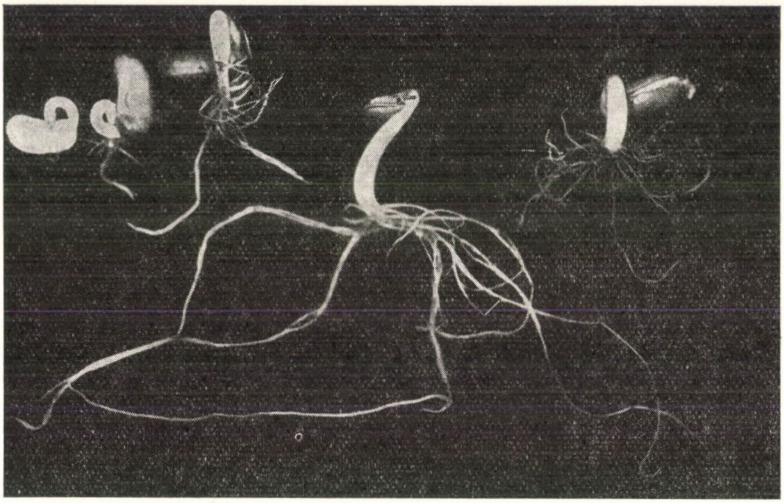

Fig. 1. Plants treated with adenine in various stages of development. On the right side: the check-plant germinated in distilled water

We have performed our experiments with the seedlings of the scarlet runner, *Phaseolus coccineus* L. The bean seeds were germinated in Petri dishes of 20 cm in diameter and the test material was arranged into series consisting of 5 dishes each. The seeds were held on filter paper wetted with distilled water. Then in swollen state of the seeds the regulating substances were added and the treatment was reiterated four times. The growth regulating substances were added in the following concentrations and quantities:

Growth-regulators	Concentration mg/l	Quantity ml/dish
Adenine	50	15
β-indole acetic acid	100	15
2-chloro-fluorenol-9-carbonic acid-methyl ester	200	15
9-hydroxy-fluorenol-9-carbonic acid-butyl ester	200	15

A part of seeds was germinated throughout the experiment on filter paper soaked with distilled water so as to check the results obtained with other series. The development of seedlings was observed for 14 days and during this time measurements were made and photos taken.

Among the seedlings developed under the influence of various treatments — as regards their roots — characteristic differences were observed. The effect of the adenine manifested itself as early as the first days of the germination. The small radicle emerging from the swollen seed coat elongates intensively and meanwhile the basipetal lateral roots appearing on the border of the neck of the radicle and of the hypocotyl are also developing rapidly. Showing extensive elongations their length and width reach dimensions that are 2 to 2.5 times greater than those of the untreated ones. It should be noted that the elongation of the acropetal lateral roots coming about somewhat later than the basipetal ones is less intensive.

The growth of the lateral roots as compared to that of the primary root is more intensive under the impact of 9-hydroxy-fluorenol-9-carbonic acid-butyl ester than under that of other substances. In this case the development of the primary root is very vigorous at the beginning but later on a considerable slowing down takes place. The growth of the basipetal lateral roots emerging somewhat later on the end of the elongating section of the primary root is very substantial so that the dimensions of these lateral roots reach or even surpass those of the latter ones. The development of the acropetal lateral roots is, on the contrary, fully inhibited (Fig. 2).

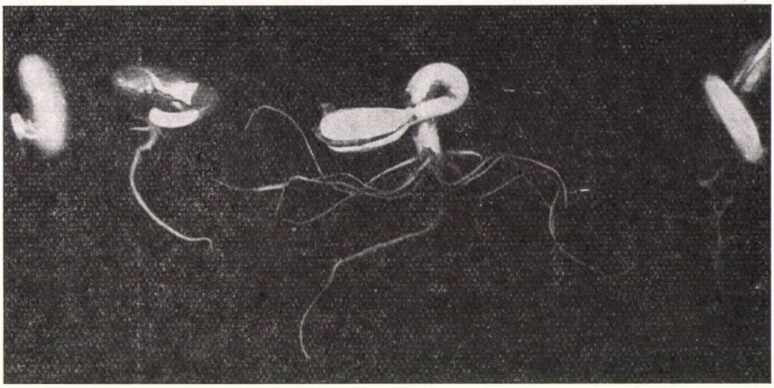

Fig. 2. Plants treated with 9 hydroxy-fluorenol-9 carbonic acid-butyl ester in various stages of development. On the right side: the seedling germinated in distilled water

The treatment with 2-chloro-fluorenol-9-carbonic acid-methyl ester has even a more inhibiting effect on the development of the lateral roots than that with the formerly mentioned compound. The growth of the radicle starts normally at the beginning but later an inhibition prevails in the development of the lateral (basipetal and acropetal) roots. Further on, the elongation of the primary root continues but the growth of lateral ones fails to come about. From the fact that the hypocotyl, passing with a sharp transition into the primary root, is more thickened than usual, a certain initial stimulus to the lateral roots might be inferred (Fig. 3).

In the case of a further treatment not only the lateral roots but the growth of the primary root are also inhibited. Under the influence of β-indole acetic acid the primary root continues to grow for a short time but on reaching a length of 5 to 10 mm its further elongation comes to a standstill, and the basipetal lateral roots growing closely one above the other appear in the shape of lathlike growth. It is out of this elevation, that the lateral roots reaching a length of 2—5 mm grow out. The development of the root does not yet discontinue, only shifts over to the hypocotyl elongated considerably and 10 to 15 mm long roots of shoot origin are being formed closely one above the other in 4 rows in the ortostichon of the incompletely developed basipetal roots (Fig. 4).

Summing up the initial results of our investigations we may say that the growth-regulating substances used in our experiments exert a rather specific influence both on the development of the primary root and on that of the (basipetal and acropetal) lateral roots, i.e. they either promote or inhibit the appearence of them.

Fig. 3. Plants treated with 2-chloro-fluorenol-9 carbonic acid-methyl ester in various stages of development. On the right side: the seedling germinated in distilled water

Fig. 4. Plants treated with β-indole acetic acid in various stages of development. On the right side: the seedlings germinated in distilled water

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TAKE, YIELD AND SEED NUMBER/FRUIT AS INFLUENCED BY THE DEVELOPMENTAL STAGE OF THE SCION

On the eggplant (*Solanum melongena* L.) the problem has been examined what the extent of the scions' take is when plants of different developmental stage are transplanted. On stocks being of the same developmental stage and of the same variety, plants of different developmental stage have been transplanted. The stages of development had started with the zygote and lasted on the individual developed from the embryo till the forming of the ovule, — i.e. from fertilization to fertilization. Thus, this has comprised the ontogenesis of the transplanted plant, both the sporophyton and gametophyton generations. The developmental stages of the sporophyton generation have been divided into three main étapes, i.e. when the plant or its transplanted organ used as scion, was in the different stages of embryogenesis, of the vegetative and reproductive phases.

In the étape of embryogenesis transplantations were performed in three developmental stages, — when the embryos were 5, 10 and 20 days old in the generative organs of the plant used as scion. The fruits containing embryos of 5 and 10 days were transplanted in such a manner that the pedicle of the plant used as stock was cut in a way that the part remaining on the plant should be about 1 cm. In the middle of the pedicle remaining on the plant, a cut was made lengthwise and in this was placed the fruit to be transplanted. The pedicle of the latter was cut, by one-one cutting, into V-formation. The pedicles thus fitted together had been tied round with a thread, then they were disinfected. After this, wet cotton was placed on them and they were isolated in order to produce more moisture content at the cut surfaces and around the fruits used as scions containing 5 and 10 days old embryos. When transplanting the 20 days old embryos, part of the fruit was transplanted on the fruit of the variety used as stock. On the fruits of the varieties used as stock and as scion, the cut has to be made on the basal part of the fruit perpendicular to the longitudinal axis of the fruit where there are no seeds in the fruit. Namely, if the cut is done in the apical part where the seeds take place, the fitted fruit parts will not get set.

When transplantation is performed in the different stages of the vegetative and reproductive phase, the stock is always a plant being in the developmental phase of 7—8 foliage leaves, before the beginning of budding. The plant used as scion is in the different stages of ontogenesis, viz.:

a) the germinating seed is still in the soil; only the hypocotyl bent arch-like, just tou of the soil (seedling), *b)* the hypocotyl got already straightened and the cotyledons that had been closed so far, have opened (cotyledonous plant),

c) the primary foliage leaves have already developed (plant of primary foliage leaves),

d) the plant is in the budding stage (budding plant).

When transplanting seedlings, cotyledonous plants and those having primary foliage leaves, the stem of the stock was cut off horizontally, 1.5 cm above the 4th foliage leaf. On the stump of the stem opposite to the uppermost leaf, a longitudinal cut or opening had been made. On this spot the prepared scion was inserted, or, with the aid of a grafting needle, the phloem was separated from the woody part at the cambium and here was placed the plantlet being used as scion. On the latter a longitudinal cut was made. The cut went alongside the hypocotyl and, in about 1—2 mm length it also extended over the radicle. The scion thus prepared, was placed into the cleft or into the hole made by the aid of a grafting needle; then the grafting surface was fastened with thread. The transplantation of the budding plant was performed by tongue grafting and by cleft grafting.

Table 1

Take, yield and seed number as influenced by the developmental stage of the scion

Developmental stage of the scion / Examined property	Sporophyton generation							Gametophyton generation flower
	Embryos of			Vegetative			Reproductive	
	5	10	20	shoot				
	days			Seedling	Cotyledonous plant	Plant with foliage	Bud	
Take of grafting, %	5.71	38.33	66.66	71.93	63.58	91.71	95.10	—
Yielding grafts, %	5.00	35.00	38.33	37.86	32.49	44.65	67.29	—
Number of seeds in the fruits	128.50	90.00	26.50	420.20	353.47	492.41	592.91	—

When transplanting organs containing the gametophyton generation (primary embryo sack, secundary embryo sack, ovule), the transplantation was made similarly as when transplanting fruits containing embryos being 5—10-day-old after fertilization. Of the different transplantations 100—200 were made per variant. With the methods described, we managed to transplant plants and their organs, respectively, being of different developmental stage. The rate of the take, of the yield as well as the number of seeds in the fruits are shown in Table 1.

If we use as scion the zygote, quadrant, octant, embryo covered with the surrounding tissue, of the individual being pollinated with its own pollen; or, if the plants being in the vegetative and reproductive phase are transplanted on another individual, the rate of the take of the transplanted organs and scion, respectively, their yield and the number of seeds in the fruits will be the greater the more advanced is the stage of ontogenesis of the sporophyton generation in which the transplantation occurs.

However, when transplanting organs that contain embryos of various development, the average number of the seeds in the fruits will decrease with the advance of the embryo's age (128.5, 90.00, 26.50). It is with reason to raise the question what the cause of this decrease is. There are two difficulties in giving an answer. One of them is that in the case of embryos of different age, without killing them, the rate of the percentage in seed-setting cannot be established. Therefore, in our investigations, we had to start from the supposition that when transplanting embryos of different age, the rate of seed-setting was the same. The other problem lies in the fact that when the development of the fruit and the seed is completed, which occurs 70—80 days after pollination, no killed embryos and seeds, respectively, can be evinced in the ripe fruits. Therefore, it is supposed that the young, 5-day-old embryos' nutrient demand can be supplied by the stock through the scar-surface or the scion can be supplied with its own nutrients, but — at least temporarily — in the 10-day-old embryos that can happen to a less degree and even to a less extent with 20-day-old embryos. In such cases, due to the temporary lack of nutrients, part of the embryos might get killed. Most probably, this is the cause of the decrease in the seed number which occurs when aging the embryos.

In the ontogenesis of the plant used as scion, there is a crucial time: the cotyledonous stage of the plant, when the take of grafting, the yield and the number of seeds in the fruits have a minimum value. This stage of ontogenesis coincides with the process when the heterotrophe nutrition of the plant is changing to the autotrophe one.

Our investigations carried out so far have shown that we do not yet have such a transplantation method elaborated with the aid of which we might transplant efficiently organs containing the gametophyton generation (primary embryo sack, secondary embryo sack, ovule) so that these should set, bring fruit and in the fruits seeds should develop.

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REPRESENTATIONS OF CAMELS IN A HUNGARIAN MEDIEVAL CHRONICLE

The contemporaneous representations and descriptions might submit valuable information for the scientist not only on prehistoric and early historic domestic animals, but can also complete our knowledge, with valuable data, concerning the domestic fauna of the Middle Ages. Though there is no doubt that the domestic animals of olden times can be made acquainted with primarily through the examination of biological material and the bone remains from excavations, still representations and contemporary descriptions may also serve our purpose. This seems to be necessary on revealing rare species of domesticated animals or investigating such characteristics of our early domestic animals as — while examining their bones — can hardly or not at all be determined. These are e.g. their colour, their marks, piebaldness, condition, hairs, their use, their stabling, etc.

The animal representations might have considerable role also in the studies referring to early Hungarian domestic animals. Unfortunately, as prehistoric animal figurines are frequent in Hungary, just as seldom come we across those belonging to the period of the Hungarian conquest (9th century A.D.) and to the Middle Ages, respectively. Moreover, those belonging to the Middle Ages fail in an essential point: they often are mere adoptions of similar foreign representations, so they cannot submit Hungarian animal species or breeds. Therefore, when making use of these, it is always necessary to examine them thoroughly: first of all, we have to start their evaluation from the aspect of the history of art, — if their Hungarian origin has been accepted by art history, we have to examine whether they can be accepted also by historical zoology in full knowledge of the authentic bone material and the zoogeographical situations of Hungary. A good example of this kind of investigations is the identification of the old Hungarian sheep shown in the picture "Calvary" of Master M. S., the best Hungarian painter in the Middle Ages.[1]

A similar, however, even more particular problem has arisen in connection with the animal representation of a miniature found in the chronicle called "Képes Krónika" and representing the conquest of the Huns being considered to be the ancestors of the Magyars (Hungarians).[2] The picture shows a mountainous landscape with fortresses, donjons. It is in the foreground where the Huns come in on horseback (mostly riding heavy horses of the occidental type), armoured warriors, among them the chieftain clad in gala robes. In the right hand of the warriors there is a banner jutting out from the frame of the picture. On the banner there is to be seen the mythical eagle of the ancient Hungarians ("Turul") being depicted here as a falcon-like black bird against a red background. In the middle there follow men and women carrying sacks and children on their shoulders, finally, there come women and children on carriages with canopy (the horses drawing the carriages are being driven by men sitting in saddle). Behind the carriages pedestrians are visible and two warriors riding camels. Of the camels only their neck and head are visible: the other parts of their body are hidden by the procession, but even under these circumstances they can be well identified (see: Fig. 1). It cannot be determined, however, whether they are dromedaries (*Camelus dromedarius* L.) or two-humped Bactrian camels (*Camelus bactrianus* L.). The only visible harness on the camels is a bridle; from this, on the left of the animals, there starts a simple rein (not the usual double reins as used with horses) and this is held by the rider sitting on the back of the animal. The riders themselves are wearing oriental garments, caftans.

In connection with the above representation two questions suggest themselves: 1. From the viewpoint of the history of literature and art, might the picture of the "Képes Krónika" be considered of authentical Hungarian origin? — 2. Was it possible that, in the Middle Ages, camels used to live in Hungary — and if so, what species and how did they come in?

There is no doubt about the Hungarian origin of the "Képes Krónika". — Studies carried out in the field of the history of art and literature have dealt with it very thoroughly and it is proved to have been compiled in the sixties of the 14th century at the Hungarian Royal Court.[3] It was based upon the "Gesta Hungarorum", then continued with the age of King Géza II and the "Gesta" of Kézai Simon; the matter was completed with the history of King Róbert Károly till 1332.

In order to give an explanation to the second question, let us summarize, briefly, the origin of the domesticated camel and its European history.

The camelids came from North America through the Bering Strait to the Old World. The place and time of their earliest domestication is not known exactly. Though Duerst has proved the existence of the camel from Anau (3000—2800 B.C.),[4] the animal's being domesticated is not proved. We face the same situation in the case of the camel of Shah Tepé identified by Amschler (3000—2500 B.C.).[5] Similarly Childe has doubted the authenticity of the camel remains of the Tripolye-culture.[6] The first illustration of the two-humped camel originates

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[1] Bökönyi, S. (1964): Művészet (Art) V, 44—45.

[2] Képes Krónika (Illustrated Chronicles). 7. (The description of the miniature by Cs. Gárdonyi, K. In: Képes Krónika. 1964, Budapest 52.)

[3] With this problem we do not want to deal in details; we rather refer to D. Dercsényi's summarizing evaluation in which plenty of literary references are available. (In: Képes Krónika. 1964, Budapest 7—44.)

[4] Duerst, U. J.: Animal Remains from the Excavations at Anau. In: Pumpelly, R. 1908: Explorations in Turkestan. Expedition of 1904. Washington, 341—399.

[5] Amschler, J. W. (1940): Tierreste der Ausgrabungen von dem "Grossen Königshügel" Shah Tepé, in Nord-Iran. Rep. of Sci. Exped. N. W. Prov. of China (Sino-Swedish Exped.) **9**, 77 ff.

[6] Zeuner, F. E. (1963): A History of Domesticated Animals. London, 359.

from Uruk-Warka (4th millenium B.C.);[7] being, however, conventionalized to such an extent that it cannot be decided whether it was domesticated or not. Anyway, the first domestication might have happened during the 2nd millenium B.C., since in the days of Zoroaster (the determination of the period is rather uncertain; it, however, seems to be about the 10th to 8th century B.C.) the camel had already been a well-known domestic animal in Persia.[8] Hence it got, from time to time, also to Mesopotamia where its excellent representations have survived. Thus, e.g., on the gate of Balawat (the times of Shalmaneser, around 850 B.C.) well-determined two-humped camels of Armenian origin can be seen.[9]

In Europe it was in South Russia that the camel — the two-humped form — first appeared; it came here through Transcaspia and the Lower-Wolga region. Its earliest appearance can be traced back to Kamenskie Kunchuguri (5th to 3rd century B.C.).[10] Camels used

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[7] Schauenburg, K. (1955—56): Bonn Jahrb., **155/156**, 61.

[8] Zeuner, F. E. (1963): 360.

[9] Ibid.

[10] Calkin, V. I. (1964): Economy of East European Tribes in the Early Iron Age. VII. Intern. Congr. of Anthrop. and Ethn. Sci., Moscow, 7.

to live also in Greek colonial towns at the northern shore of the Black See; their bones were found, though very rarely, at excavations. Thus, from the Hellenic-Roman layers of Skifskii Neapel, Pantikapei, Ilurat, Fanagoria 1—2 camel bones came to light, while 46 bones (of 5 animals) revealed themselves at Tanais,[11] and in the 1st—5th century layers (A.D.) 12 remains (2 animals) were found.[12] During the Migration Period and in the early Middle Ages the situation was similar. In the layers of the 6th--12th centuries A.D.[13] of Kiev, in Borsevo I (9th—10th century)[14] and in the capital of Volga—Bulgaria (in the layers of the 12th—13th and 13th—14th centuries)[15] its further remains were found. As can be seen, both the Russian and Ukrainian camel remains have come to light from the southern steppe-areas of the two regions. During the Migration Period the camel reached — along the northern shore of the Black Sea —, also Roumania. From Garvan (Dinogetia, 9th—12th centuries) a single camel bone is known.[16]

It was the Roman Imperial Period when camels first came to Central Europe. From Vindonissa (Switzerland) Kraemer,[17] from the Roman layers of Vienna Berger and Thenius,[18] from Epfach (Abodiacum, Germany) Boessneck[19] have identified camel bones, most probably those of the Bactrian camel. To these is attached the mandible fragment of a camel found at the Roman settlement Tác-Fövenypuszta (Hungary), but it being from a layer that had been disturbed by diggings in the Middle Ages, its authenticity cannot be considered sure. The camels of the Roman Age were brought along by military units from Asia Minor or North Africa to the European provinces; after the forces had been called back, the camels, too, disappeared from here.

In the last period of their migration to west, the Hungarian conquerers covered the same route on which, during the Migration Period, camels had been kept everywhere. Though we have no evidences, it seems to be almost sure that in these areas also the Hungarians, used to keep camels. On the basis of analogies of the Árpádian Period (the age of the Árpád dynasty, 897—1301) it is well-known that the Magyars mainly kept such animals (cattle, horses, sheep) that could be easily driven from one place to the other and that could well stand the dry climate of the large, grassy plains. It is reasonable to suppose that these animal species included also the camel; this must have been the two-humped camel which got better acclimatized to the continental climate than the dromedary which rather prefers the hot temperature. The fact that camels did live in Hungary in the Árpádian Period, is proved by a written source originating from the 12th century: When, in 1189 the Emperor Frederick Barbarossa passed through Hungary with his crusaders, according to the priest Amsbert being in his retinue, King Béla III residing then in Esztergom, gave the crusaders bread, oats for the horses and also oxen, sheep and — three camels.[20]

On the basis of the above, the miniaturist of "Képes Krónika" has rightly painted camels because, most probably, these had existed among the domesticated animals of the Hungarian conquerers, and were living here in the first centuries of the Middle Ages, maybe even in the age of the Anjou dynasty (14th century). The artist must have known about

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[11] Calkin, V. I. (1960): MIA **53**, 50.

[12] Pidoplichko, I. G. (1956): Materialy do vivchennia minulih faun URSzR. II. Kiev, 92

[13] Pidoplichko, I. G. (1956): 65.

[14] Gromova, V. I. (1948): MIA **8**, 122 sk.

[15] Calkin, V. I. (1963): MIA **61**, 277.

[16] Georghiu, G.—Haimovici, S. (1965): Anal. Stiint. ale Univ. "Al. I. Cuza" d. Jasi. **IX**, 181.

[17] Keller, C. (1919): Geschichte der schweizerischen Haustierwelt. Frauenfeld, 42.

[18] Berger, W.—Thenius, E. (1951): Veröff. d. Hist. Mus. d. Stadt Wien. 20 skk.

[19] Boessneck, J.: Die Tierknochenfunde aus den Grabungen 1954—57 auf dem Lorenzberg bei Epfach. In: Werner, J. (1964): Studien zu Abodiacum-Epfach., Bonn, 218.

[20] Szamota, I. (1891): Régi utazások Magyarországon és a Balkán-félszigeten (Oldtime Travellings in Hungary and on the Balkan Peninsula). Budapest, 19.

the oriental origin of the camel. It is for this reason that he shows the camel's riders in oriental wear. The colour of the camels is also well hit proving that he might have seen camels in his life; however, the fact that he does not show their hump (or humps) seems to be a contradiction since the hump is the most characteristic, most conspicuous part of that queer-looking animal. Knowing the migratory route of our ancestors, Middle Age-camels of Hungary seem to have belonged to the Asiatic form.

Osteologically, the existence of the camel in Hungary could be proved in the Turkish period only: in the Turkish layers of Buda and Diósgyőr the fragment of a humerus and that of a maxilla have been found. However, it is most probable that these bones are not from the Asiatic two-humped camel but from the African one-humped dromedary.

S. Bökönyi

THE PETIOLATE ROOTING OF BEGONIA SEMPERFLORENS

According to literary data the rooting by the leaf-scions of the *Begonia* is stimulated by heteroauxin, while it is inhibited by kinetin. There exists an antagonism between the adventive bud and root formation (Heide 1965) by enhancing the concentration of IAA the development of the adventitious roots of the petiole are also increased (Turetskaya 1966). Similar results were experienced by Soekarjo (1966) with the *Coleus* scions. The rooting of *Tradescantia* scions and the growth of shoots are inhibited by kinetin (Humphries 1963). The rooting of the *Tradescantia albiflora* scions and that of isolated leaves are inhibited in agreement with the above said (Horváth 1968). The root formation of *Begonia* leaves is inhibited by 10^{-4} M kinetin (Bigot 1966). Bastin (1966) described that the root formation induced by auxin was due to the increased biosynthesis of compounds being of phenolic character.

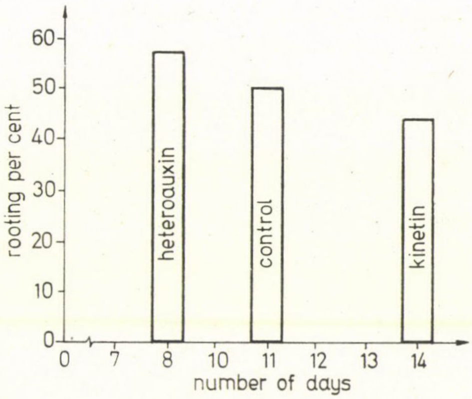

Fig. 1. Rooting per cent in the function of time

In our experiments we have made use of the multiplied individuals of one clone of *Begonia semperflorens*. The leaves being cut with their stalk, were placed, for two hours, in a tap-water solution of 10^3 mg/l IAA and 2.2 mg/l kinetin. After the treatment the propagation was performed in rinsed river-sand. Then 0.2 ml 10^3 and 10^4 mg/l IAA as well as 2 and 2.2 mg/l kinetin solution were added to a 1.5 per cent agar-agar in which the leaf-stalk scions were placed. The measuring of the peroxidase enzyme activity was carried out on the Spektromom 360 photometer at 420 millimicron (Kisbán *et al.* 1964).

Under the conditions known by literature (NUERNBERGH 1966) rooting has started, in general, on the 9th day in the case of scions treated with IAA, with the control plants this has occurred on the 11th day, while with those treated with kinetin, on the 14th day (Fig.1). In the percentage of rooting the difference has showed itself distinctly. As an effect of IAA treatment this is 57 per cent, with kinetin treatment 44 per cent and with the controls it is 50 per cent (Fig. 2).

The death of control scions being treated with IAA was quicker and greater than with those treated with kinetin. At high temperature (40° C) the start of rooting generally coincided with the total rooting, viz., the adventitious roots developed immediately, in full number. Kinetin increased the life-time of the leaves. After cutting the leaf-stalk scions, on the 14th day only 37 per cent died.

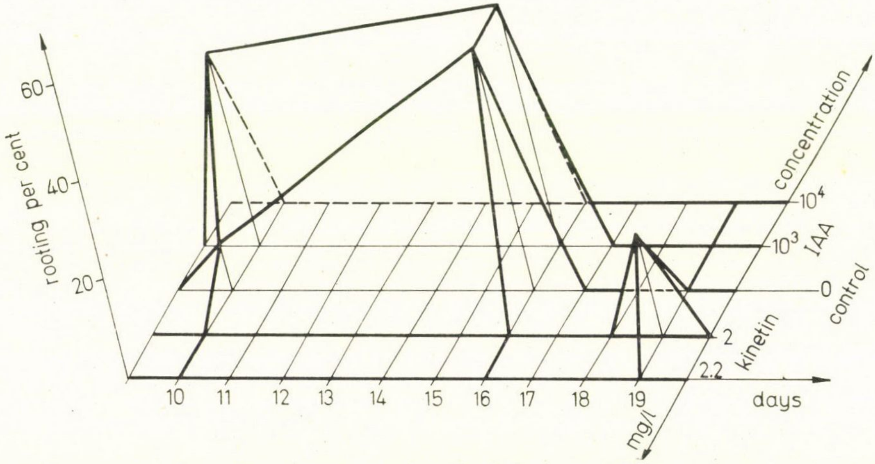

Fig. 2. Percentage of rooting occurring under the influence of different treatments and concentration

In the second part of the investigations two kinds of kinetin and IAA concentrations were used in agar-agar; with the controls 0.2 ml distilled water was added to the nutrient substratum.

The stimulating effect of the 10^3 mg/l IAA and the inhibiting effect of the 2.2 mg/l kinetin appeared also here, however, the other kinetin concentration and the 10^4 mg/l IAA were inhibiting as well.

From the stalks and blades of the removed leaves the peroxidase enzyme activity was measured right after cutting. No activity could be evinced from the stalk of the leaf (Fig. 3).

Four days after cutting the enzyme was examined again: In the leaf-blade the activity of peroxidase was increased and enzyme activity proved to be found also in the stalk of the leaf, this latter — however — being only 25 per cent of the activity in the leaf-blade (Fig.4).

On the 16th day the enzyme activity of the leaf-blade is unchanged as compared with the result of the 4th day, still it decreases to a great extent in the leaf-stalk. Following this, the peroxidase activity gradually decreases in the leaf-blade, too.

The change of enzyme activity in the function of time is shown in Fig. 5.

There, it can be seen the enzyme activity of rooted and non-rooted leaves; the enzyme activity of the former decreases to a smaller extent. Influenced by IAA treatment, the activity

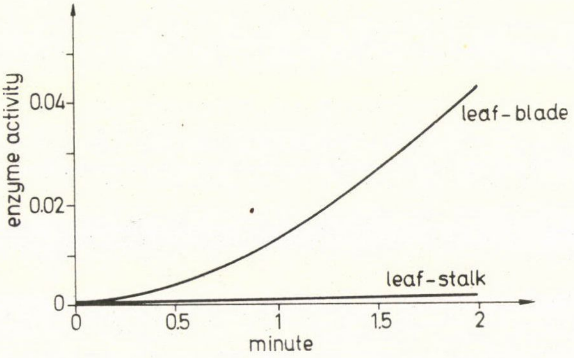

Fig. 3. Peroxidase activity of freshly cut leaves

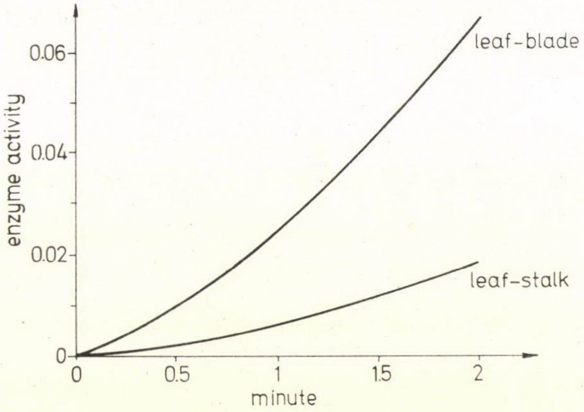

Fig. 4. Peroxidase activity measured on the 4th day following cutting

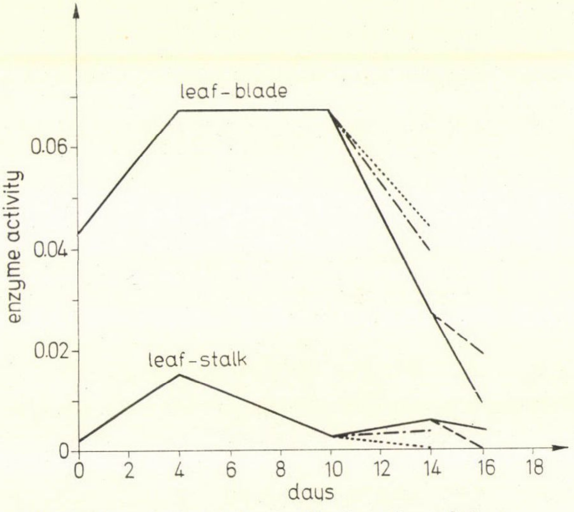

Fig. 5. Enzyme activity in the function of time

of peroxidase is higher than in the control. After rooting the enzyme activity in the leafstalk is 0.

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GENETIC STUDY ON TRITICUM MONOCOCCUM L. REDUCED FROM TETRAPLOID TO DIPLOID

Reduction of artificial autotetraploid plants to the original diploid level is a rather frequent phenomenon explained differently by the authors. Morrison—Rajháthy (1960) consider gene mutation to be its cause. Others suggest that — as it is a question of chromosome complement duplication — it is a mutation of chromosomes rather than one of genes that occurs. This view is supported by Forlani in his work published in 1954 (Forlani 1954). Heribert-Nilsson (1955) does not consider artificial autotetraploids produced by colchicine treatment to be real polyploids. According to the authors mentioned above reduction to the original diploid level is caused by cell division being disturbed.

Authors mention cases when only the number of chromosomes is reduced to the diploid level while the polyploid effect remains. In this case the tetraploid character becomes constant. According to Bálint (1964) Morgan called the attention of research workers to this phenomenon as early as in 1937.

The present paper gives an account of the genetic analysis of plants reduced to diploids from artificial autotetraploid specimens of *T. monococcum* L. var. *flavescens* ($2n = 28$) produced with a 0.02 per cent solution of colchicine in 1955 at our Department (Rajháthy 1957).

Chromosome number of 209 plants which had been registered as *T. monococcum* L. by previous investigations was checked on Szalay's initiative and bulk of the plants was found diploid.

Beginning with 1961 the plants having reduced to diploids as regards their chromosome number have been sown strictly separated from both tetraploid and originally diploid *T. monococcum* L. (latter sown as control) and sufficient number of each of the three variants have been studied.

Besides the phenological observations morphological and quantitative features of the plants were individually examined.

For cytological examinations root tips were fixed in Carnoy's solution, stained with carmine acetic acid and smears were prepared of them. We are indebted to our colleague Balla for his contributing to our cytological studies.

According to our studies performed in 1961 and 1962 there was no difference in earing, flowering and waxen ripeness between tetraploid plants of *T. monococcum* L. and those reduced to the diploid level. Both variants ripened 4—6 days later than the originally diploid *T. monococcum* L. In later years (1963—1967) there were minor differences in earing, time of flowering and ripening between reduced and originally diploid plants.

According to our observations in the first two years plants reduced to diploids were similar in habit to tetraploids. The darker colour of leaves of the tetraploid *T. monococcum* L. as well as the upright position of leaves and shorter and stronger straw were characteristic of them. Later the morphological character of reduced plants became more and more different from that of the tetraploid plants and similar to that of the originally diploid *T. monococcum* L.

Table 1

Quantitative properties of the three variants of Triticum monococcum L.

Year	Combination	Number of plants	Height of plants, cm			Grain per ear number		
			$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	s	$s_{\bar{x}}$
1961	1.	20	143.0	3.3	1.1	40.4	4.6	1.3
	2.	13	113.0	10.0	2.7	27.0	21.9	3.5
	3.	9	80.8	16.2	5.4	14.0	10.7	3.6
1962	1.	92	119.0	0.7	0.1	25.0	6.2	0.6
	2.	84	109.0	39.1	4.2	22.0	1.2	0.1
	3.	84	92.2	0.7	0.8	8.4	0.4	0.1
1963	1.	12	115.0	6.8	2.0	41.6	4.8	1.4
	2.	9	98.8	0.8	0.3	23.5	3.6	1.3
	3.	50	77.8	0.9	0.1	8.9	0.9	0.1
1964	1.	41	122.3	6.3	1.0	38.6	9.7	1.5
	2.	44	121.5	5.3	0.8	28.6	6.8	1.0
	3.	50	96.4	8.3	1.2	19.8	8.9	1.3
1965	1.	30	—	—	—	28.0	1.7	0.3
	2.	30	—	—	—	22.8	1.4	0.2
	3.	30	—	—	—	16.6	1.2	0.2
1967	1.	20	120.6	5.7	1.3	35.3	5.4	0.4
	2.	16	120.2	6.9	2.1	33.1	5.7	0.5
	3.	20	98.9	8.1	3.4	18.5	7.6	0.7

Table 1 cont.

Year	Combination	Number of plants	Earlets per ear			Length of ears, cm		
			$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	s	$s_{\bar{x}}$
1961	1.	20	40.8	3.2	1.0	9.7	0.6	0.2
	2.	13	25.3	2.1	0.6	9.0	0.8	0.2
	3.	9	25.6	2.2	0.8	10.2	1.9	0.6
1962	1.	92	31.0	0.5	0.0	8.1	0.8	0.1
	2.	84	30.0	0.5	0.0	7.4	0.2	0.0
	3.	84	23.7	0.2	0.0	7.5	0.8	0.1
1963	1.	12	37.6	0.8	0.2	9.5	0.2	0.0
	2.	9	29.2	0.7	0.2	8.2	0.1	0.0
	3.	50	20.3	0.2	0.3	7.3	0.2	0.0
1964	1.	41	32.2	1.3	0.2	8.1	0.8	0.1
	2.	44	27.8	1.8	0.3	6.7	0.7	0.1
	3.	50	25.0	2.4	0.3	9.5	1.2	0.2
1965	1.	30	30.2	2.0	0.4	7.7	0.2	0.0
	2.	30	28.9	1.8	0.5	7.1	0.3	0.1
	3.	30	26.3	0.4	0.1	9.6	0.2	0.0
1967	1.	20	32.9	2.4	1.1	10.2	0.8	0.2
	2.	16	31.3	2.4	0.7	7.9	0.5	0.3
	3.	20	25.5	2.1	0.8	9.6	0.6	0.4

Note: 1. diploid *T. monococcum* L.
2. *T. monococcum* L. reduced
3. tetraploid *T. monococcum* L.

As regards the top-view and shape of glume no differences were found between the three variants of *T. monococcum* L. The grain was found in every case to grow sharp at the end and — from side-view — to make a small angle (below 45°) with the embryo. There was, however, a slight difference in the ventral side of the grain. Namely, in the first years the ventral side of grains of tetraploid and reduced plants was rather convex while that of the diploids was concave. A low number of grains with a straight ventral contour line were also found in each of the three variants. Grains of reduced *T. monococcum* plants became later more and more like those of the diploids.

The majority of glumes examined had slightly curved small sharp teeth and arched acute-angular shoulders. Glumes with blunt teeth and oblique and serrated shoulders respectively have been found, but very scarcely.

Quantitative properties of the three variants of *T. monococcum* L. were also examined in the years of 1961—1967. Tables 1 and 2 show that while in 1961—63 reduced plants of *T. monococcum* L. occupied a definitely intermediate position concerning most quantitative properties, in the subsequent years they came close — or in some cases became equal (especially as regards plant height, number of earlets per ear, length and width of grains and glumes) to the corresponding values of diploid *T. monococcum* L. The initially low and gradually increasing fertility of tetraploid and reduced plants of *T. monococcum* L. as compared to that of the original diploid plant was also observed. In 1961 the former two variants had 14 and 27 grains per ear respectively while in diploid plants this value was 40 on the average. In 1967 number of grains per ear of the reduced plants came close to that of the diploids.

Thousand-grain-weight of reduced plants proved to be about 10 per cent less (29.3 g on the average of several years) than that of the tetraploids and was nearly the same as the thousand-grain-weight of diploid plants. The average length of ears was less in both variant — except in 1963.

The chromosome number of *T. monococcum* L. reduced to the diploid level is 2n = 14, similar to that of the original diploid. Tetraploid plants of *T. monococcum* L. have 2n = 28 chromosomes. According to our observations coupling of homologous chromosomes of reduced plants took place more or less undisturbed. Both in tetraploid and reduced plants a low number of rings formed by 3—4 chromosomes, chromosome fragments and univalents have been observed and even an unequal distribution of chromosomes at the two poles occurred.

Cytological examinations suggest that in some of the tetraploid plants the chromosome complement is abruptly reduced to the diploid level. The possibility of a spontaneous crossing between diploid and tetraploid plants of *T. monococcum* L. is excluded by the fact that no triploid hybrids have been observed.

Thus, our data suggest that quantitative properties of *T. monococcum* plants reduced abruptly to the diploid level are not constant but show a slow, gradual qualitative and quantitative reversion. Even in 1967 they were not quite similar to the original diploid *T. monococcum* L.

Table 2

Quantitative properties of the three variants of Triticum monococcum L.

Year	Combination	Length of grains, mm			Width of grains, mm		
		$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	s	$s_{\bar{x}}$
1961	1.	7.6	0.6	0.1	2.8	0.5	0.1
	2.	8.0	0.7	0.1	2.9	0.5	0.1
	3.	9.1	1.7	0.2	3.2	0.6	0.1
1962	1.	7.4	0.7	0.2	3.6	0.4	0.0
	2.	8.7	0.5	0.1	3.8	0.5	0.2
	3.	9.0	—	—	3.9	—	—
1963	1.	8.9	0.5	0.2	3.1	0.5	0.2
	2.	8.9	0.5	0.2	3.3	—	—
	3.	9.4	0.7	0.1	3.9	0.5	0.1
1964	1.	8.1	0.6	0.3	3.1	0.6	0.1
	2.	8.3	0.5	0.1	2.8	0.5	0.1
	3.	9.7	1.1	0.3	3.9	0.8	0.2
1965	1.	7.8	0.1	0.0	4.0	0.2	0.0
	2.	7.9	0.1	0.0	4.1	0.2	0.0
	3.	9.1	0.1	0.0	4.5	0.1	0.0
1967	1.	9.1	0.6	0.0	3.2	0.2	0.1
	2.	8.5	0.8	0.0	3.0	0.1	0.0
	3.	9.5	0.8	0.0	3.6	0.1	0.0

Table 2 cont.

Year	Combination	Length of glumes, mm			Width of glumes, mm		
		$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	s	$s_{\bar{x}}$
1961	1.	9.8	1.6	0.4	3.0	0.4	0.2
	2.	10.5	0.5	0.1	3.6	0.5	0.1
	3.	11.2	2.2	0.7	3.8	1.0	0.3
1962	1.	9.1	0.6	0.1	3.4	0.4	0.1
	2.	9.2	0.1	8.7	3.7	2.4	7.3
	3.	9.3	—	—	4.0	—	—
1963	1.	9.3	0.8	0.4	3.1	0.5	0.2
	2.	9.5	0.7	0.3	3.3	0.4	0.2
	3.	9.6	0.8	0.2	3.6	0.3	0.2
1964	1.	9.6	1.9	0.5	3.4	0.5	0.2
	2.	10.0	0.8	0.3	3.6	0.7	0.1
	3.	10.7	0.6	0.2	3.8	0.6	0.2
1965	1.	10.8	0.2	0.0	3.6	0.1	0.0
	2.	10.8	0.2	9.0	3.7	0.1	0.0
	3.	10.9	0.2	0.0	3.9	0.1	0.0
1967	1.	11.0	0.3	0.2	3.8	0.3	0.1
	2.	10.0	0.5	0.1	3.6	0.5	0.3
	3.	10.4	0.4	0.0	3.8	0.4	0.2

Note: 1. diploid *T. monococcum* L.
2. *T. monococcum* L. reduced
3. tetraploid *T. monococcum* L.

Mass chromosome reduction took place in plants that were not yet constant tetraploids. Later, in the course of regular cytological control examinations a considerably lower number of plants having 2n = 14 chromosomes were found among the tetraploids.

*

Prepared by the Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár.

A. Belea

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ORGANIZATION OF THE PISTIL IN CALENDULA OFFICINALIS L.

After having dealt with the development of the pistil in the *Helianthus annuus* L. we intend — in the frame of the present paper — to report on our investigations concerning the developmental conditions of pistils at the *Calendula officinalis*. Individual authors hold rather different opinions about the pistil's organization in the family *Compositae*. According to some of them besides carpels the other floral leaves, i.e. calyx leaves, petals and staminal leaves participate as well in the formation of the pistil (appendicular theory; Duchartre 1841, Köchne 1869, Martin 1892, Koch 1930, Stebbins 1940, Douglas 1944, Snow 1945, Kasapigli 1951, Douglas 1957, Takthayan 1959), while others maintain the view that it is the torus that encloses the ovary and grows together with it (axial organization; Buchenau 1872, Baillon 1888, Szabó 1923, Schaffner 1937, Gracza 1966).

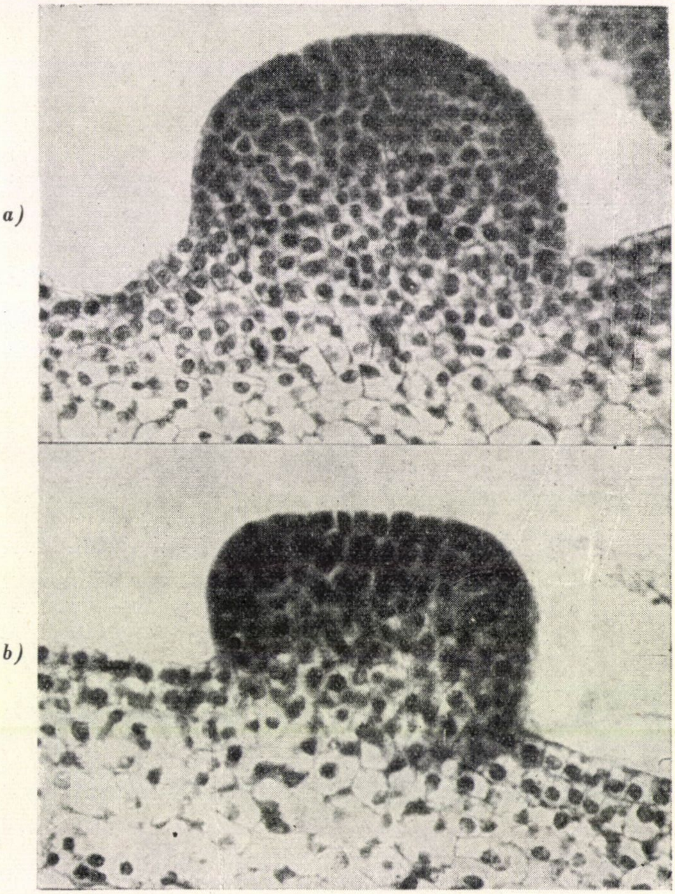

Fig. 1. a) The disk-flowers of *Calendula officinalis* in the state of a cup-shaped primordium (obj. 40 ×, oc. 5 ×). *b)* As a result of further cell divisions the peripheral part of the flower primordium rises and gets flat-surfaced (obj. 40 ×, oc. 5 ×)

The test material for our investigations, i.e. inflorescence of the *Calendula* of various stages of development, has been gathered from the Botanic Gardens of the Loránd Eötvös University every two—four days. After having been treated microtechnically in the usual way the material has been embedded, cut-off with a microtome, dyed, covered and then examined. In addition, microphotos have been taken of the characteristic parts. It should be noted that the organization of the pistils both of the ray-flowers formed on the edge of the inflorescence and of the inner disk-flowers, too, has been followed with attention.

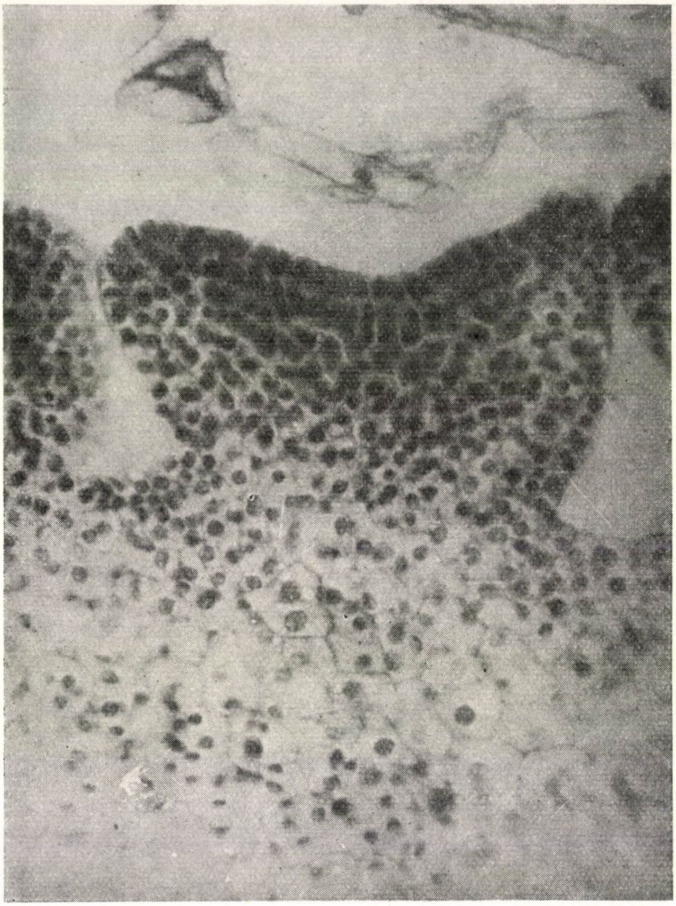

Fig. 2. The petal primordium in a state of initial organization (obj. 40 ×, oc. 5 ×)

The conical vegetative shoot apex of the *Calendula officinalis* is covered by a three-layer tunica. In consequence of the intensive function of the edge-meristems the shoot apex gradually gets wider and thus a hemispherical reproductive apex is formed. Owing to the intensive periclinal and then anticlinal cell divisions beginning in the third layer of the tunica, flower primordia of centripetal character appear on the surface of the shoot apex of the inflorescence. The growth of the flower primordia, cup-shaped at the beginning, comes to a stop on reaching the height of 10—14 rows of cells (Fig. 1a) and the intensity of the cell divisions shifts over to the peripheral part of the flower primordia, as a result of which their surface gets more and more wide and flat (Fig. 1b). The cell divisions may be observed on the peripheral part further on, too. This results in the formation of five petal primordia and then, through the cell divisions starting centripetally inwards on the surface of the primordial flower, five alternately positioned stamen primordia, and on the innermost spot two carpel primordia are formed. On the extreme ray flower primordia two carpel primordia emerge immediately after the petal primordia (Fig. 2, 3 and 4).

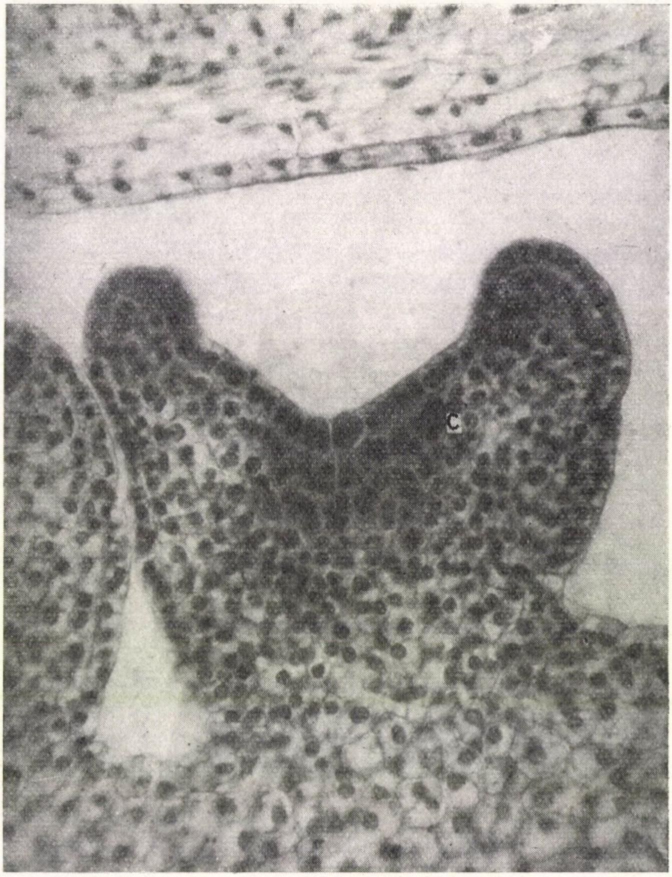

Fig. 3. On the primordial-ray flower within the petal primordia the initiation of carpels is starting (c), (obj. 40 ×, oc. 5 ×)

On the primordial ray flowers the carpel primordia are growing upwards in the beginning and then as a result of the more intensive division and lengthening of the cells of the dorsal side they bend inwards and form the cavity of the ovary and further on bending together they give rise to the primordial style of the flower. In this state the tissue of the torus in the vicinity of the still meristematic tissue of the primordial ovary is consolidating, its cells are considerably extending, in consequence of which the growing petals and stamina surpass the level of the ovary. This, among others, accounts for the phenomenon that during the development the tissue of the torus is gradually growing around the ovarial part of the developing pistil and the latter practically sinks into the former. The pistils of the disk flowers develop only incompletely although the sunken position of the compressed ovary can also be closely followed up there (Figs 5 and 6).

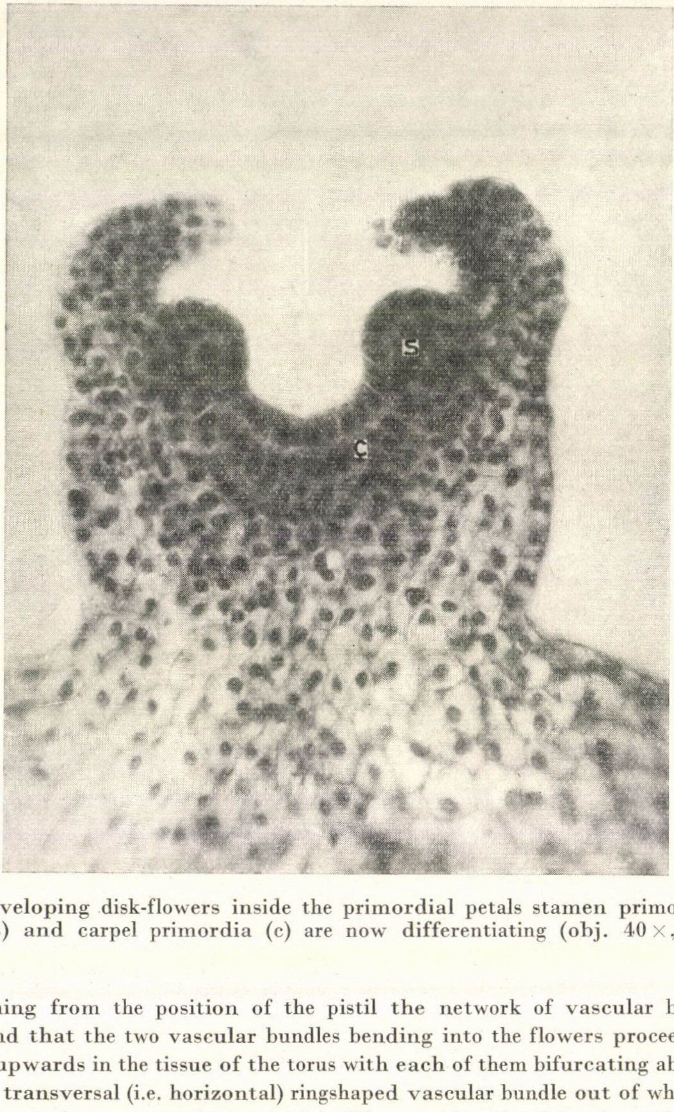

Fig. 4. On developing disk-flowers inside the primordial petals stamen primordia has been formed (s) and carpel primordia (c) are now differentiating (obj. 40 ×, oc. 5 ×)

Examining from the position of the pistil the network of vascular bundles in the flower we found that the two vascular bundles bending into the flowers proceeded along the median plane upwards in the tissue of the torus with each of them bifurcating above the ovary and forming a transversal (i.e. horizontal) ringshaped vascular bundle out of which the petals, stamens and the styles were starting upwards, while some bundles rising from the ring covered the ovary with a network (Fig. 7).

An important characteristic feature for judging on the pistil being low-positioned or not is the so-called nodal level marking the border of the torus and the origin of the petals. This can be well proved in the ray- and disk-flowers of the *Calendula*. In the completely developed flowers a groove running around somewhat above the ovary and noticeable from the

Fig. 5. Carpel primordia bending towards each other are forming the hollow of primordial ovary and the style (st) in the developing ray flowers of the *Calendula officinalis.* The differentiation of vascular bundles has already started (obj. 40 ×, oc. 5 ×)

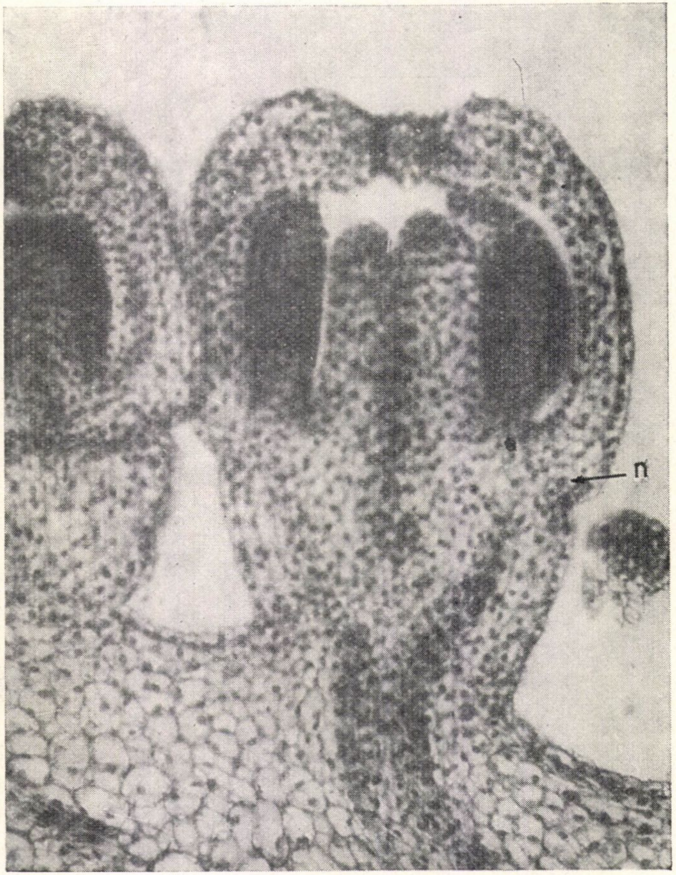

Fig. 6. In the young disk-flowers nodal level (n) is above the incompletely developed ovary (obj. 40 ×, oc. 5 ×)

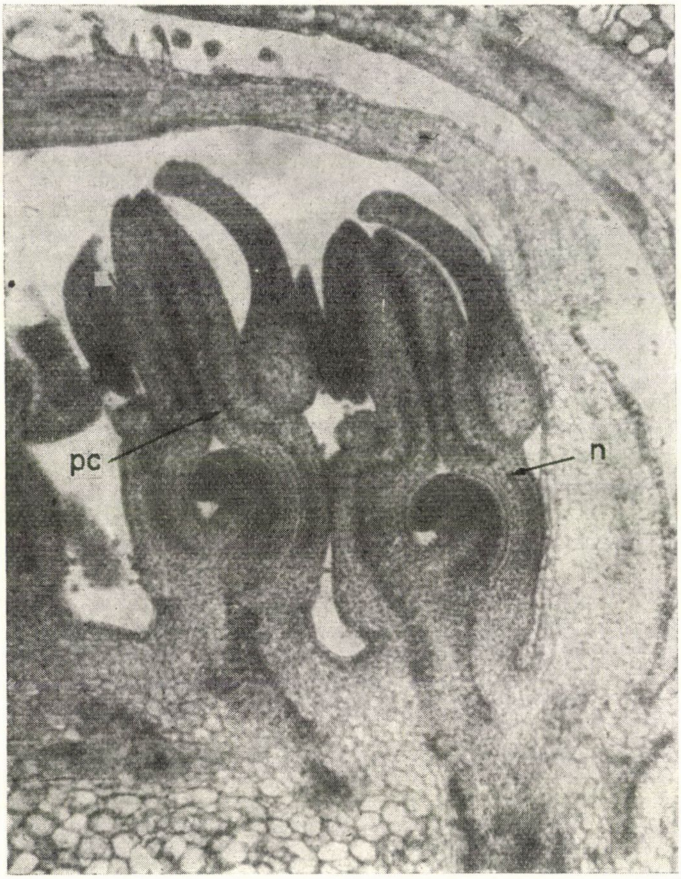

Fig. 7. In the young ray-flowers petal bundles (pc) are bending out of the torus bundles above the ovary. At this height is the nodal level (n), too (obj. 20 ×, oc. 5 ×)

beginning of the development can be observed which then takes a definite shape, thus showing distinctly the upper boundary of the torus (Figs 6, 7 and 8).

The results of our investigations can be summed up as follows: on the basis of the peculiar features shown in the organization of the flower, the character of vascular bundles, the forkings in the bundles of the petal above the ovary and on the basis of the nodal level of the flower the conclusion can be drawn that the pistil of the *Calendula officinalis* proved to be typically low-positioned and of axial organization.

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Prepared by the Department of Applied Botany and Hystogenesis, Loránd Eötvös University, Budapest.

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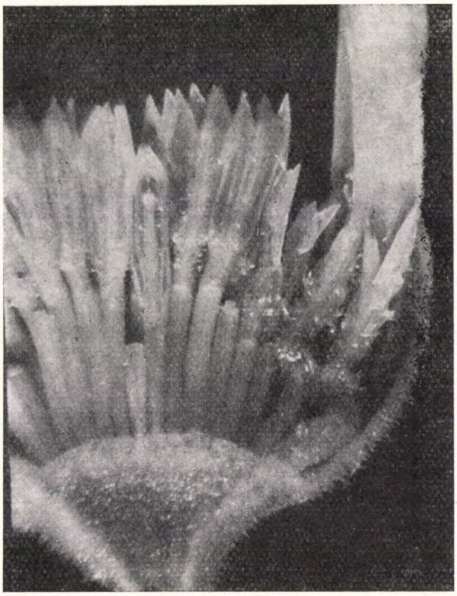

Fig. 8. The nodal level is well visible in the fully developed ray- and disk-flowers (obj. 1 ×, oc. 6.3 ×).

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CONTRIBUTION TO THE GERMINATION PHYSIOLOGY OF SOME DOMESTIC VARIETIES OF PANICUM MILIACEUM L. AND SETARIA ITALICA (L.) PAL. BEAUV.

Germination physiological aspects of domestic varieties of *Panicum miliaceum* and *Setaria italica* are hardly known. Their requirement of germination temperature was studied by Haberlandt (1874 in Lehman—Aichele 1931) who found that between 16° C and 37.5 °C germination was of 100 per cent and fell suddenly to about 30 per cent only at a temperature of 44° C. In the course of her studies on sodium tolerance Ivanitskaya (1964) treated millet, barley, maize and cotton with sodium carbonate solution of 0.01 per cent and found a good sodium tolerance.

We have studied the effects of temperature and several salts on grains of some domestic varieties of *Panicum miliaceum* L. and *Setaria italica* (L.) Pal. Beauv. for the purpose of characterizing them from a germination physiological point of view.

The following millet varieties were used in laboratory examinations: *Fertődi 2; Fertődi fehér; Martonvásári VE 1; Mezőhegyesi piros; Debreceni barna magvú* (after-crops of 1967 at Tápiószele) — and the following varieties of *Setaria italica: Debreceni vörös* (1963); *Mezőhegyesi sárga* (1964); *Martonvásári sárga* (1965).

3×100 grains per treatment of each variety were germinated in Petri dishes between two layers of filter paper kept constantly wet. The sequence of temperature (5, 10, 15, 20, 25, 30, 35, 40, 45 and 50° C) was provided by refrigerators and biological thermostats. At temperatures of 45 and 50° C grains of the well germinating varieties *Panicum miliaceum* (*Fertődi fehér* 1967) and *Setaria italica* (*Martonvásári sárga* 1965) were germinated.

Experiment on salt tolerance was performed with the same varieties. Germination temperature was 25° C; germ beds were wetted with the following solutions: sodium chloride, potassium chloride and calcium chloride of 0.5, 1.0 and 2.0 per cent.

Controls were set in parallel and simultaneously. Number of germs were recorded on fix days and daily, respectively at the same time, thus information on the intensity of germination could be obtained as well.

In the course of studying germination at successive temperatures we found that varieties of *Panicum miliaceum* and *Setaria italica* germinate equally well at temperatures between 10° C and 45° C (Table 1).

None of the varieties germinated at 5 and 50° C. Among the varieties of *Panicum miliaceum* (they were of the same year and could thus be compared to one another) *Mezőhegyesi piros* and *Fertődi fehér* germinated in 93 per cent at a temperature as low as 10° C. In general, germinative ability was almost equally very good — nearly 100 per cent — between 15° C and 30° C, except for the variety *Fertődi 2*, which showed a somewhat lower percentage.

When studying germinating power we found the highest rate of germination at 35 and 40° C, as the number of germs was maximum already 24 hours after germination had begun; germination was finished on the second and third day while at lower temperatures it was somewhat prolonged: at 15° C to about 7 days, at 10° C to about 14 days.

Varieties of *Setaria italica* showed a similar trend: germination of older grains was slightly slower, and percentage germination was lower, too. Though here, too, the rate of germination was higher at higher temperatures, percentage germination — especially with varieties of earlier years — decreased more rapidly than with the millet varieties.

According to studies on salt tolerance (Table 2) both *Panicum miliaceum* and *Setaria italica* were tolerant to calcium chloride. Treatments with sodium chloride and potassium chloride of 0.5 and 1.0 per cent had no significant decreasing effect on the germination percentage. On the other hand, solutions of 2.0 per cent were more effective. Table 2 shows that the solution of sodium chloride is especially effective.

Table 1

Germinative ability of varieties of Panicum miliaceum L. and Setaria italica (L.) Pal. Beauv. (%) in the sequence of temperature
Tápiószele, 1968

Varieties	Year of growing	Percentage germination at temperatures of									
		5	10	15	20	25	30	35	40	45	50° C
Panicum miliaceum											
Fertődi 2	1967	0	62	77	85	85	80	72	62	—	—
Fertődi fehér	1967	0	93	97	97	99	98	97	93	90	0
Martonvásári VE 1	1967	0	87	98	98	99	98	97	96	—	—
Mezőhegyesi piros	1967	0	93	97	99	99	99	98	98	—	—
Debreceni barnamagvú	1967	0	89	98	99	98	97	97	91	—	—
Setaria italica											
Debreceni vörös	1963	0	66	72	83	83	72	56	28	—	—
Mezőhegyesi sárga	1964	0	56	70	72	72	63	51	32	—	—
Martonvásári sárga	1965	0	89	95	95	97	93	86	85	80	0

Table 2

Changes in percentage germination under the influence of various salt solutions
Tápiószele, 1968

Varieties	Year of growing	Control	Germination % under the influence of								
			NaCl			KCl			$CaCl_2$		
			0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0
			%			%			%		
			solutions								
Panicum miliaceum *Fertődi fehér*	1967	99	97	94	50	93	95	62	93	96	87
Setaria italica *Martonvásári sárga*	1965	97	89	79	8	89	89	47	95	87	69

There is a significant difference between *Panicum miliaceum* and *Setaria italica*, since the former did not react to any of the salt solutions to such extent as the latter did; it showed a germination of 50 per cent even under the influence of a 2 per cent solution of sodium chloride.

Thus, our investigations show that some varieties of *Panicum miliaceum* and *Setaria italica* grown in Hungary germinate very well between 15° C and 40 °C. Studies on salt tolerance suggest that *Panicum miliaceum* is more tolerant to sodium-, potassium- and calcium chloride than *Setaria italica*. Effect of 2 per cent solutions of sodium chloride is especially conspicuous.

*

Prepared by the National Institute of Agrobotany, Tápiószele.

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USE OF MATHEMATICAL METHOD IN THE INVESTIGATION OF THE RELATIONS OF THE MICROELEMENTS OF POTENTILLA ARENARIA BORKH. POPULATIONS AND OF THEIR SOILS

It is of great importance and very interesting to establish statistical and mathematical relations in the case of biological experiments. Recently the importance of using biometrical methods has been developing both in the appreciation of botanical and zoological experiments and in the planning of new biological investigations. The aim of the present paper is to establish mathematical relations in the microelement content of *Potentilla arenaria* populations and of their different soils. Now the method is given only and the work in detail is to be published elsewhere (SIMON—TÖLGYESI 1968).

For our investigation the following plantecological experiment has been performed. From three different arable lands we collected *Potentilla arenaria* populations. The soils were the following: 1. sand (Csévharaszt), 2. dolomite (Csíki hegyek; Budaörs), 3. andezite (Füzérvárhegy). The collection was made from 10—10 different sample areas. The surface of each sample area was 3 m^2; and from all of the areas were collected plants weighting 2 dkg; and we took soil from beneath of the plants weighting 30 dkg.

After collecting the material by use of chemical method we determined the microelement content of soils available for the plants (K, Na, Ca, P, Zn, Cu, Mn, Fe, Mo), and in the case of elements K, Na, Ca and P the results were given in unit of gramm/kilogramm, and in the case of the other ones Zn, Cu, Mn, Fe and Mo in unit of milligramm/kilogramm. The measurement was made with 1 n dissoluting hydrochloric acid. In the same way, with 0.1 n hydrochloric acid the microelement content of the plants was estimated, and the results were given in the same units (Table 1).

During the mathematical appreciation three chief questions arose:

A) Is there any significant difference in the element content available for plants of the different soils?

B) Is there any significant difference in the element content of plants collected from the different soils?

In that case, if there was a significant difference in the element content available for plants of different soils, and if there was a significant difference in the element content of plants, we could raise the third question:

C) Does the significant difference of the element content of plants depend on the significant difference of the element content available for the plants of different soils?

In such a case, as we consider only one difference, e.g. we investigate the microelement content of the different soils, or examine the microelement content of the plants the most suitable way — for getting a good result — is the use of variance analysis. However, if we consider two or more differences, or examine the relations of various significant differences, or like in previous case we examine the relations of the element content of different soils and of populations collected from different soils, then the application of covariance analysis would be the most adequate method.

First of all we had to range our data for getting groups suitable for mathematical analysis. The different soils were indicated: 1. sand, 2. dolomite, 3. andesite; these data con-

Table 1

Na and Mo content of the different soils and populations

	X			Y		
	1.	*2.*	*3.*	*1.*	*2.*	*3.*
Na						
a	0.09	1.70	0.17	0.30	0.35	0.32
b	0.11	1.80	0.18	0.33	0.33	0.26
c	0.12	3.20	0.15	0.35	0.33	0.29
d	0.15	3.00	0.14	0.36	0.33	0.26
e	0.11	1.60	0.15	0.37	0.33	0.27
f	0.14	4.00	0.16	0.37	0.39	0.29
g	0.14	3.50	0.15	0.33	0.35	0.30
h	0.10	3.50	0.15	0.33	0.35	0.30
i	0.13	2.00	0.14	0.35	0.34	0.27
j	0.09	3.30	0.16	0.36	0.33	0.26
Mo						
a	0.03	0.12	0.22	0.35	0.80	0.35
b	0.17	0.17	0.07	0.50	0.82	0.18
c	0.11	0.06	0.08	0.46	0.57	0.20
d	0.07	0.16	0.11	0.35	0.66	0.14
e	0.10	0.10	0.17	0.32	0.70	0.59
f	0.19	0.10	0.08	0.43	0.74	0.15
g	0.06	0.56	0.10	0.47	0.73	0.25
h	0.13	0.15	0.09	0.42	0.70	0.24
i	0.12	0.10	0.07	0.45	0.75	0.17
j	0.10	0.13	0.11	0.38	0.70	0.17

stitute the different treatment. Within individual soils the different sample areas were indicated with abc: a, b, . . . , j; these values are the respective repetitions. The element content of the soils available for plants got the sign X, the data of element content of different population is marked as Y. The designation of the origin of the different populations is equal to that of the soils: 1, 2, 3, and a, b, . . . , j; Finally for all of the elements there were 3 treatments, and in the individual treatment were 10 repetitions, then for one element 30 data are presented.

Following our earlier expositions the analysis was made by means of two phases. The first one involved two variance analyses — with these two analyses we tried to give answer to the questions of A and B. Table 2 shows the method of the significance estimation. The second phase is an answer to the question C — it is a covariance analysis shown by Table 3. The data of our analysis are found in the Table 4.

Following from our data we can draw some interesting conclusions, that may be of ecological and physiological interest.

Table 2

Estimation of significance in the case of variance analysis

Variance	SAQ	FG	MQ
Total		29	
Treatment		2	
Within group		27	

$$F = \frac{\text{MQ treat.}}{\text{MQ w. group}}$$

Table 3

Estimation of significance in the case of covariance analysis

Difference from the regression line	$d^2{}_{y \cdot x}$	FG	MQ
Total		28	
Within group		26	
Among groups		2	

$$F = \frac{\text{MQ a. groups}}{\text{MQ w. group}}$$

Table 4

F-values of the different elements

Element	F		
	X	Y	XY
K	93.50	69.04	38.59
Na	99.48	*4.54*	*4.40*
Ca	950.67	26.35	24.76
P	1000.00	78.20	16.60
Zn	13.23	37.21	37.11
Cu	23.59	*3.12*	*2.90*
Mn	32.32	32.06	26.14
Fe	295.59	*4.93*	*4.74*
Mo	*1.35*	109.80	—

Table 5

Different F-values used by the author

X	$F_{0.01}$ (2, 27) = 5.49
Y	$F_{0.01}$ (2, 27) = 5.49
XY	$F_{0.01}$ (2, 26) = 5.53

Considering the data of element Na, the ion content available for plants of different soils appeared to be different (the difference was significant), but the ion content of the populations collected from different soils seemed to be at the same level (the difference was not significant). Summarizing what has been said, in the case of *Potentilla arenaria*, we can suppose that the Na ion content of the different soils has no influence on the Na ion content of plants. That is, in our case the plants did not absorb the greater quantity of element Na, but they did it as ad libitum (this quantity seems to be equal in the case of the different samples). The same figure appears in the case of Cu and Fe, too.

Following the data of element Mo, we can establish that the Mo content of different soils shows no significant difference —, i.e. the quantity of element Mo in different soils was about equal — while the quantity in the populations collected from various soils did show a difference.

*

Prepared by the Department of Plant Taxonomy and Plant Geography of the L. Eötvös University, Budapest.

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INCORPORATION OF RADIOCARBON LABELLED N^6-BENZYLADENINE INTO THE INSOLUBLE RNA FRACTION OF BEAN LEAF TISSUES

McCalla *et al.* (1962) reported that benzyladenine is incorporated into RNA fraction of leaf tissues, but at a very low rate only. In contrast Fox (1964) demonstrated in an earlier report that benzyladenine was incorporated into the insoluble fraction of RNA at a greater rate (15 per cent), presumably not in an unaltered form but after a breakdown into adenine, so only adenine was incorporated. Fox (1966, 1967) and Letham *et al.* (1967) demonstrated that benzyladenine is incorporated first of all into the soluble fraction of RNA, which probably contributes to an increase in the transport mechanism of activated amino acids. In our investigation we aimed at determining whether the benzyladenine incorporates in unchanged form into the insoluble fraction of RNA, or it decomposes by metabolic pathway and its products are incorporated.

In order to reveal whether unchanged benzyladenine or products of its breakdown are incorporated into the insoluble fraction, we prepared 8-^{14}C-benzyladenine and 2'-^{14}C-benzyladenine as well. In preparing both these labelled benzyladenines, the method of Whitehead *et al.* (1960) was used. The 8-^{14}C-benzyladenine was produced from 124.6 mg/0.92 mmole labelled 8-^{14}C-adenine. We obtained 106 mg (52 per cent) crystalline product, of a yellow-white colour. (Melting point was 223° C.) In preparing the labelled 2'-^{14}C-benzyladenine, the method of WHITEHEAD *et al.* (1960) was modified by us; 250 mg (0.74 mmole) benzylamine picrate, radiocarbon labelled in the methylene group (2'-^{14}C) of 28 mg (0.26 mmole) specific activity has been used for the synthesis. The compound was placed in 0.8 ml N sodium hydroxide solution into the flask of microdistillatory apparatus. 1.1 ml (1.1 mmole) N hydrochloric acid was placed into the receiver. The distillation was performed gradually to 230° C. 1 ml of abs. alcohol was added to the dry residue of distillation and the distillation continued. Water and ethanol were distilled subsequently from the receiver and 270 mg (2.6 mmole) benzylamine and 135 mg (1 mmole) adenine added to the residue and the above process was repeated. The preparatum obtained was 71 mg of 2'-^{14}C-benzyladenine, which corresponds to 32 per cent calculated on adenine. (Melting point 218° C.)

Purity of our products has been determined chromatographically using Whatman No. 3 paper and compared to the Rf value of p.a. adenine, kinetin and benzimidazole. Then 100 gamma from each compound were pipetted on the paper. The mixed solutions contained 9 parts of normal butanol and 1 part of 20 per cent formic acid. Development was made by the ascending method for 16 h. Then the chromatograms were dried on the air; treated later with ethylacetate Dragendorf reagent; dried at 100° C, and treated with N/20 sulfuric acid. The background of the paper turned into black, and the compounds gave different colours (Table 1).

Table 1

Rf values of model compounds (mean values of 9 parallels)

Base	Rf	Colour-reaction
Adenine	0.16	rubinred
Benzyladenine	0.74	yellow orange
Kinetin	0.65	yellow orange
Benzimidazole*	0.41	red orange

* The cytokinin activity of benzimidazole was reported earlier (POZSÁR et al. 1967), thus its RF value was determined in this experiment.

Table 2

Incorporation of 8-^{14}C-adenine, 8-^{14}C-benzyladenine and 2'-^{14}C-benzyladenine into the RNA fraction insoluble in 10 per cent trichloroacetic acid

The bean leaf tissues contained 67 per cent water and 0.84 mg protein

Purinbase	Specific activity of prepared compounds mc./mmole	Specific activity of external solution c.p.m. × 10³/ml	Incorporation c.p.m./100 mg fresh weight	Mean error of mean value	Specific activity c.p.m./mg N	Incorporation rate in per cent of that of adenine
8-^{14}C-adenine	11.40	342	16 842	245	20 050	100
2'-^{14}C-benzyladenine	1.30	256	114	28	135	6.75
8-^{14}C-benzyladenine	0.36	291	98	22	116	5.80

In our investigations the discs were taken from Pinto bean leaves and floated for 3 hours on the surface of the radioactive solutions, having nearly an equal activity in c.p.m. per ml. After repeated purifying we determined the activity of RNA insoluble in 10 per cent trichloroacetic acid. Table 2 shows that both radiocarbon labelled benzyladenines are incorporated into the insoluble fraction of nucleic acid at the same rate. The incorporation rate of both labelled benzyladenines is very low, as compared to that of adenines (POZSÁR—MATOLCSY 1968). These findings directly demonstrated that both labelled benzyladenines were incorporated in unchanged form into the insoluble fraction of RNA of bean leaf tissues.

*

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WINTER BARLEY MEZŐHEGYESI 68

(Mezőhegyesi 68 őszi árpa)

Taxonomic place: Hordeum vulgare L. convar. *vulgare* MSF. var. *paralellum* Körn. (MANSFELD 1950).

Origin: developed from a local variety of Mezőhegyes with individual selection.

Beginning of breeding: 1932. Medgyesegyháza.

Breeders: Ferenc Szüllő and Pál Varga, Kiszombor.

State qualification: first certification 1939, first entry into the state register 1951; state registered improved variety (KAPÁS *et al.* 1965).

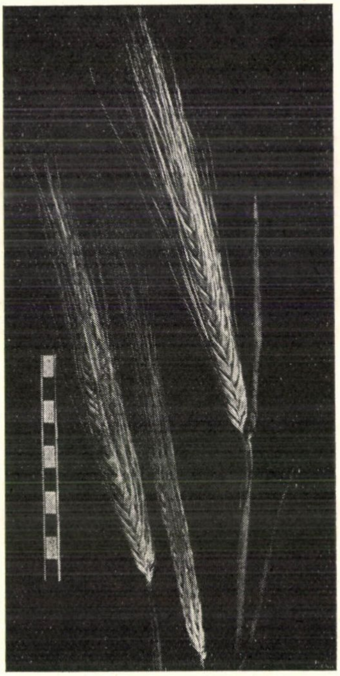
General characterization: irregularly six-rowed winter barley, good winter-hardy, of rapid early development, early ripening, productive.

Morphological description:

Root system: vigorous, deeply penetrating.

Shoot system: with its rapid early development and stooling forms a thick stand. Leaves (shoots) of young plants prostrate in autumn.

Stem: 107 cm on the average (ranging between 91 and 114 cm), long. Tends to lodging (value: 1.6 : 5 = perfectly stable); nodes cylindrical. The normal stem is straight below the spike, on the apex "collar" is of closed "A" type (ÅBERG—WIEBE 1948).



Foliage: leaf blade medium wide, of medium green colour, linear-lanceolate. The leaf sheath naked, medium waxed. Flag leaves are medium wide, short, their blades more or less twisted and leaf apex remains below the ear. Auricles of upper leaves are of lilac-red colour (contain anthocyane).

Ear: large (5.9—7.3 cm), irregularly sixrowed, compact. Aristae long, ruddy at the apex, otherwise of straw-yellow colour. Number of ears 314—339 per m^2. Number of grains per ear ranges between 28 and 48 (Horváth 1954, 1957). Rachis straight decurrent, internode of the rachis short-haired only at the edges. Basal part of the rachis is short and straight. Glumes narrow, bristle-like, apex aristated, blade slightly glabrous. Weight of grains of the ear ranges from 1.4 g to 2.0 g.

Caryopsis: large, full. The grain with lemma is large, wide spindle shaped. Its colour straw-yellow. Thousand-grain-weight 37—46 g, hl-weight 54—65 kg. Grain/straw ratio: ranges between 1 and 2.6. In the grains the digestible protein 6.9—8.1 per cent, starch content 47.5—49.2 per cent.

Biological characters

Germination: its cardinal points: minimum 3.5° C, optimum 10° C, maximum 40° C. The period of germination in the optimum is 3—4 days. Dormancy of seed depending on seeding date 78—86 days (Mándy 1966).

Vegetation period from seeding to earing 221—238 days, from seeding to waxen ripeness 240—270 days (Horváth 1963, Mándy 1965).

Development: good growth vigour. When sown early it develops more slowly than when sown later. Earing is generally early, but waxen ripeness medium early (Mándy 1965, 1967).

Winter hardiness: good, though frost without snow-cover causes damages (which is compensated by its good tillering). Winter-kill only 3.3—24.8 per cent (under snow-cover) and 39—48 per cent, respectively without snow-cover (HORVÁTH 1954).

Resistance to diseases: more than medium resistant to powdery mildew (its value is: 2.87; 1 = highly infested). Somewhat susceptible to black rust, though its natural contamination is low (Em per cent = 0.54; BÉKÉSI 1967).

Demands on farm technology

Seeding: in Hungary it is best sown between the 20th and 30th of September (MÁNDY 1965). Seed requirement 2—2.5 million germs per cad. hold (1 cad. hold = 1.422 acres) (KAPÁS *et al.* 1965).

Soil: it is not particular about soils, but loess-soils of high nutrient content are favourable for it (KAPÁS *et al.* 1965).

Productivity: national average grain production ranges between 14.5 and 21.2 q/cad. hold (25.5—38.8 q/ha), while straw yield between 26.5 and 40.1 q/cad. hold (46.1—69.7 q/ha) (HORVÁTH 1957, 1963).

Growing district: gives the highest yields on the Békés—Csanád loess-table and in the Körös-district (KAPÁS *et al.* 1965).

GY. MÁNDY

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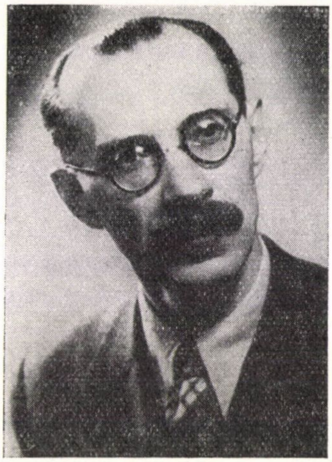
CHRONICA



BERTALAN HAZSLINSZKY

1902—1966

On January 19 of 1966 Bertalan Hazslinszky passed away after prolonged physical and psychical sufferings both of which he had accepted with great patience; though his illness had lasted long, his decease seemed to come suddenly. This country has been bereft of a highly esteemed researcher in applied plant anatomy and microscopy.

He was born in Budapest on November 2, 1902 as the son of Géza Hazslinszky, a judge and lawyer and his wife Márta Lányi. Although his father was a jurist, in his family there prevailed other kinds of traditions since his grandfather Frigyes Hazslinszky had been one of the pioneers and outstanding men in Hungarian botanical research work; his uncle Sándor Mágocsy-Dietz was professor of botany and later, of "General Botany" at the University of Arts and Sciences, Budapest. Of his father's two brothers one was a physician while the other became professor of agricultural college.

He had attended the elementary then the secondary school in Szekszárd and Nyitra and then in Budapest where he also passed his final exam. Later he immatriculated at the Medical Faculty of the above-mentioned university, however, after six terms he went over to the Faculty of Arts in order to study natural history and chemistry. In the year 1927 he got his doctor's degree in general botany this being the main subject, and in geology and chemistry as subsidiary subjects.

In his doctoral dissertation he elaborated the anatomy of the vegetative organs of *Prunus nana*. This work was accomplished at the Institute of General Botany of the University; here he had been working since 1926; first in the capacity of a research student and later as assistant professor.

In the course of these activities he got acquainted with and trained himself in the research method of plant anatomy and microscopic examinations.

At the end of the year 1928 he got into the State Chemical Institute being engaged there in microscopical food inspection. Here he was working until the end of 1940 and then transferred to Szeged, in the capacity of professor, to the Botany Department of the Teachers' Training College.

During his previous work in Budapest he was entrusted, in 1931, to deliver lectures on botany at the Veterinary College (Later: the Veterinary Faculty of the "Palatine Joseph" University of Technical and Economical Sciences); here he did research work also in the field of veterinary botany as a result of which the Veterinary Faculty qualified him as a honorary lecturer in the field of "Veterinary plant-knowledge with special regard to medicinal and poisonous plants". Bertalan Hazslinszky performed these duties till 1944.

In Szeged, times becoming more and more difficult, there was no possibility to display greater activities at the College, and yet here, too, he continued to do, in an intensive manner, microscopic work begun at the State Chemical Institute. As a result he acquired his second degree being now qualified as honorary lecturer in the theme "The microscopy of agricultural products". In the year 1950 he was pensioned and thus had to quit his chair.

Bertalan Hazslinszky was then entrusted with directing the Biological Department of the Szeged Group of the Society of Natural Sciences. Besides, he worked also in the local Museum, and in 1951 he became, as scholarship holder, researcher of the Hungarian Acad. of Sci., employed at the Botany Institute of the Szeged University. In 1953 he was restored to his former activities and appointed, in the capacity of chief engineer, to the Chemistry and Food Inspection Institute of Budapest where he had been working as the leader of the biological laboratory, up to his retirement in 1963.

In his family life, too, he had to suffer a severe blow. It was the sudden and tragical death of his wife Márta Meznerics in 1948. Remaining alone with his son, B. Hazslinszky remarried taking to wife a lady-teacher, Ilona Visontay.

The short time spent at the university is characterized by theoretical plant anatomy research work the result of which is his doctoral dissertation. When, however, he had got engaged at the State Chemical Institute, he began to deal with foodstuff microscopy in a very intensive manner. His joining in the veterinary-training turned his attention to the problems of veterinary botany.

His scientific activities had always been in close connection with his job and employment.

In the field of food inspection his first publication deals with judging the quality of roasted coffee beans by looking for explanation of judging the water-content in coffee. He was also engaged in examining red pepper and proving the adulteration of same. In a later paper he summarized the anatomy of paprika from pharmaceutical viewpoints. He also examined the cinnamon especially concerning its starch content, and described the *Cicer* being used as coffee surrogate, and in his series called "Microscopic Proceedings" he submitted, in four publications, the cases deserving attention during his work.

In the field of foodstuff-microscopy his most efficient, the most comprehensive and in many aspects pioneer activities were those connected with studying honey. Its importance lies, first of all, in having elaborated the norms of the Hungarian honeyes and the methods for examining same.

In the year 1938 appeared his first publication in this field and in this, on the basis of vast test-material, he described the anther dusts occurring in Hungarian honeys; on ground of species thus established, he tried to elucidate the origin of the honey-samples.

Afterwards he dealt — in four publications — with *Castanea* as a honey-producing plant elucidating, its flowering-biology and way of pollination by way of microscopic examination he proved a honey sample made of linden-flowers to be a surrogate. He described, in general, the pollen-analytical examination of honey; the *Stachys annua* as an apiarian plant; the honey-dew and the honey produced from it. He reported on the toxic effect of honey coming from the *Atropa belladonna.* The most intensively, however, he had been studying *Robinia*-honey submitting it to very thorough and detailed qualitative and quantitative examinations.

His activities in the field of veterinary botany are also of great importance.

His first publication in this field (1931) dealt with the intoxication of sheep by *Mercurialis* the cause of which had been *Mercurialis annua.* He similarly proved that the dermatitis of horses had been caused by *Hypericum.* In an other case he evinced the disease of horses to be brought about by *Glechoma hederacea.* On the other hand, he demonstrated, with feeding experiments, that the otherwise toxic seed of *Datura* had been innocuous when given to pheasants.

His experiences and examinations were summed up in a book of 370 p. written in co-operation with Imre Takács. The work was published in 1960 under the title: "Microscopical examination of vegetable foods and fodders".

As a man he was very modest, quiet — always ready to help and willing to share his great knowledge and wast experiences with his colleagues. Even when very ill, he gave instruction and advice, in difficult cases, to his co-workers visiting him at his home.

The first signs of his serious disease had manifested themselves in 1954; and the research worker being sound in mind and able to do constant brain-work, were bound first to his desk and then gradually more and more, to his bed so that in 1963 he was pensioned a second time. Nearly 3 years more had he to suffer bodily and in his soul; these sufferings could be eased only partly by the distinction he had been awarded as an acknowledgement of his life-work.

B. Hazslinszky's activity had been characteristic of exceedingly profound conscientiousness and thoroughness. Whenever a problem had been raised, he had never been satisfied with its simple solution but had tried to elucidate the coherences to their utmost details. This thoroughness showed its results, too. Many a great problem was solved and, new paths beaten through his work, and his results are reliable in every respect. Both his work and his personality compelled the admiration of his fellow-workers. His memory shall be cherished by all of us and his name is written, by his works of abiding value, into the annales of Hungarian science.

Z. E. KÁRPÁTI

Acta Agronomica Academiae Scientiarum Hungaricae, Tomus 18 (1—2), pp. 281—284 (1969)

RECENSIONES

T. R. G. Gray, D. Parkinson: *The ecology of soil bacteria.* (An international symposium.) Liverpool University Press, 1968.

The publication contains the lectures and the discussions of the Liverpool symposium held, under the auspices of UNESCO, in the year 1966. The 33 lectures being grouped in six domains of themes, submit a lively and very interesting review on a field of microbiology that is rather neglected, however, containing many unsolved problems. These lectures were delivered by carefully selected experts in this field, and there were animated discussions on them.

1. The environment of soil bacteria. After speaking about the physical (A. D. McLaren and J. Skujins) and chemical (J. S. D. Bacon) factors which take part in building up soil that exceedingly complicated ecological system, lectures were delivered, among the biotic factors, on soil fungi (J. L. Lockwood), on the soil fauna (A. Macfayden) as well as on the agricultural environment brought about by soil-culture and cultivated plants (E. W. Russel).

2. Methods for the isolation and estimation of activity of soil bacteria. This is, perhaps, the most interesting part of the book. The lecturers (L. E. Casida, jr; J. Pochon and P. Tardieux; D. J. Greenwood; V. Jensen; T. R. G. Gray et al.) and those taking part in the dispute honestly reveal the grave defects of the generally applied plating and dilution methods rendering all soil-biological results uncertain or, even unreliable. The difficulties that seem to be almost insoluble, are caused by the exceedingly high heterogeneity of the soil: in a single gram of soil there occur, together, thousands of microbiotopes with most heterogeneous chemical and physical peculiarities. It seems to be logical that, by applying selective culture media, the denizens of different microbiotopes may be cultivated. In this connection it is only questionable whether the given differences in the selective culture media that are being used now, represent significantly the wide range of differences involved in the microbiotopes of the soil. The problem remains permanently uncertain whether the organisms bred from the soil are working actively or reside only in a state of rest. For the time being it seems that perhaps a direct microscopic examination combined with the application of fluorescent stainings and fluorescent immune sera may contribute to getting closer acquainted with the life of soil microorganisms in the soil. The application of the direct microscopic examination is limited by the fact that for its accomplishment a large number of research workers would be required.

3. Physiology of soil bacteria. In this range of themes lectures were delivered on energetical problems (H. Veldkamp), on the synthesis of different enzymes, antibiotics and other compounds (D. Pramer), on chemolitotrophic processes (H. G. Schlegel), on the decomposition of cellulose (A. A. Imshenetsky) and that of pesticides (M. Alexander).

4. The taxonomy of soil bacteria. This chapter may claim to the widestrange of interest. Viz., the taxonomy of bacteria is problematic not only in connection with soil bacteria. In the course of the lectures and

of the discussion the different and manifold efforts were mentioned which aimed at improving the systemization of bacteria. It is the soil which has always been, and will remain for a long time, the source for discovering new species among which, most probably, there will be many organisms being important also from the viewpoint of industry. Ruth E. Gordon submitted a résumé, on the whole bacterium system, on the changes suggested since the VIIth publication of the Bergey-taxonomy book and on the methods applied when determining the Streptomyces. E. Küster spoke about the soil-actinomycetes. A. D. Rovira and P. G. Brisbane lectured on the application of the numerical taxonomy method, while lectures were delivered by H. G. Gyllenberg on the importance of Gram-staining and by J. W. Rouatt on the importance of taxonomic and ecological aspects of nutrition.

5. Bacteria in the root region of plants. Lectures on the causes and role of the formation of rhizosphere vegetation occurring on the surface of the roots (J. Macura); on the pre-infection phase of the Rhizobium symbiosis (G. Fahraeus—H. Ljunggren), on the ousting of pathogen microbes by introducing antagonist microbes: promising results have been obtained by the introduction of mycolytic bacteria and actinomycetes into soils infected through pathogen Fusaria (N. A. Krasilnikov).

6. The growth of bacteria in soil. Part-studies on the mineralization of organic substances introduced into the soil (F. E. Clark), on the regional spreading of sporiferous bacteria in the Soviet Union (E. N. Mishustin—V. A. Mirsoeva), on the bacteria of the polder soils in the Netherlands (D. A. Van Schreven—G. W. Harmsen), about the bacteria of the soil of a pine-forest in England (M. Goodfellow et al.), on the effect of iron- and manganese ions as exerted on the soil bacteria (A. J. Holding—D. C. Jeffrey), on the introduction of Rhizobium and Azotobacter culture into the soils (M. E. Brown et al.), on the occurrence of plant pathogen bacteria in the soils (J. E. Crosse), on the anaerob bacteria of soils (F. A. Skinner), and on the nitrificating bacteria (F. E. Chase et al.) as well as on the manganese cycle going on in the soil (G. A. Zavarzin).

The symposium closed with R. L. Starkey's summarizing evaluation.

The studying of this book is highly recommended to everybody who has anything to do with microbiology. Though it is also true that, if the reader is not dealing closely with soil biology, it may happen that he doesn't find data that can be directly used in his closer field of research, though even this is not considered impossible. The reason why it is interesting and worth while dealing with the problems discussed in this book is because soil is that last part of the biosphere of the earth that may still be considered a "blank spot". We know that it contains marvellous treasures: among others, it was from here that the antibiotics-producing organisms came to light. However, of the processes taking place in situ in the soil, we hardly know anything. And yet, for the majority of mankind, for the time being, it is the soil that provides the possibilities for life. Research work in soil biology is not only an exciting excursion into an unknown world; it is also destined for providing and improving our living.

J. ZSOLT

A. BÁLINT: *Heterózis és mutáció a kukoricában* (Heterosis and mutation in maize). Akadémiai Kiadó, Budapest, 1967, 182 p., 66 tables, 29 figures.

The introduction of hybrid maize resulted in a yield increase of 25—40 per cent almost unprecedented in the history of plant breeding. After this great success the rate of further progress has slowed down. The author wishes to help the maize breeders in their further progress by making them acquainted with the fundamental research work performed in the fields of heterosis and mutation, the two subjects discussed by the book. Namely it is obvious that an intensive knowledge of the phenomenon of heterosis makes a more systematic and more successful utilization of heterosis effect possible, on the other hand, significant results are expected of altering by mutation the genetic material, as results yielded by different self pollinating plant species have not so far been obtained by mutation experiments carried out with maize.

All the 8 chapters of the book consist of two parts: the first part gives a survey on literature, presenting the experimental results published in world literature in a historical succession; the second part deals in detail with the author's experiments carried out in these fields at the Plant Breeding Department of the University of Agricultural Sciences, Gödöllő in the last 10 years.

In the part written on heterosis differences in kernels found by the author between those obtained from cross- and self-pollination in the course of intensive examination are especially worth of mentioning. A large part of the book deals with differences found in the utilization of water, nutrients, trace elements and light between the lines and their single cross. A similar study on the auxin content and the composition of the bases of nucleic acid suggests that hybrid vigour is the complex effect of more than one factor. Cytological examinations revealed the effect of self-pollination on an increase in the percentage of chromosome aberrations. Variance analyses pointed out greater individual differences in the lines than in the double crosses: the author gives a logical explanation of this result unusual perhaps for genetic experts. This chapter includes also the theories of heterosis.

The part written on mutation discusses the mutations of higher plants and gives a detailed and precise picture of the progress brought about by the investigation of the mutation of maize, including the theoretical explanation of the development of mutants. Among his own experiments the author presents — in addition to ethyl-metane-sulphonate- and X-ray treatments — changes in quantitative characters of gamma radiation treatments and their variational values, supplemented with cytological examinations and the production of biochemical mutants. Practical utilization of the very promising and highly significant changes is hindered by the fact that the combining ability of lines of valuable components developed by mutation is still to be improved.

Both parts give abundant literary references and the book is completed by summaries written in Russian and English. It does not possess a corrigendum, however.

The book provides a useful assistance not only to maize breeders but also to every research worker interested in these two subjects.

L. Berzsenyi-Janosits

J. Baeyens: *Nutrition des Plantes de Culture*, E. Nauwelaerts, Louvain, Béatrice-Nauwelaerts, Paris, 1967, 678.

French literature of applied plant-physiology has been enriched by a new valuable work. Prof. J. Baeyens, director of the Institute of Soil Research of the University of Louvain treated the applied physiology of agricultural plants in a way satisfying the requirements of both university textbooks and handbooks. In the introduction author refers to his being led by the same views when writing his book as those guiding Sir John Russell in his world-known and highly esteemed work: Soil Conditions and Plant Growth.

In French-speaking territory no similar book of considerable size has been published since the fifth edition of "Croissance des Végétaux Cultivés" by Demolon, published in 1956. This book was first published in 1934. The first edition of the mentioned book by Sir John Russell was published in 1912 while the last — the 9th — one in 1956. The German "Lehrbuch der Agrikulturchemie und Bodenkunde, II. Teil, Pflanzenernährung" written by Fritz Scheffer and Erwin Welte on the same subject and published in 1955, is nearly of the same age. J. Baeyens' book is of a dimension different from — hence incomparable with — the "Handbuch der Pflanzenernährung und Düngung" written in Germany by Scharrer-Linser and published in three volumes in 1966.

Thus, research data of the last 10 years have not been processed in books of similar size; it is by this fact that Prof. J. Baeyens' work is made timely. Besides an up-to-date treatment of the subject based on world's special literature — the book containing 30 pages of bibliography — author found, of course, a way of including in his book the results of his Institute, this representative institution of the Belgian research on applied plant-physiology.

The book follows the classical system of treating agrochemistry, i.e. it is based on outer and inner growth factors. After having dealt with the role of water and atmospheric factors, author proceeds to those of chemical character, to the ash-components, then to the role of nitrogen, devoting meanwhile a chapter to the role of the root and to the problems of soil-root interactions, ion-uptake and transport. After a description of fertilizers and manures a chapter of plant-physiological character follows again: on the role of growth substances. A short chapter deals with the role of chelates in the uptake of certain cations of microelement character.

In the chapter on the rules of plant nutrition the development of Liebig's minimum-law through Mitscherlich's law to its modern form is presented. In this chapter author's own investigations are especially interesting; on the basis of the investigations made by Demolon and Boischot he found a sigmoid-shaped correlation between growth-factor and growth, in contrast with Mitscherlich's parabolic growth correlation.

Author also touches upon the methods of determining the plant nutrient requirements of soil. His standpoint in this much discussed methodological question is worth to be considered: "In general, any present method is suitable for determining the fertilizer requirement of soils provided it has been previously checked in hundreds of field experiments." (p. 490.)

In the last chapter several timely problems are dealt with: the effect of fertilizing on the quality, further, on the amino-acid- and vitamin content; the problems of pesticide residues are also dealt with in this same chapter.

For those who wish to make use of the text-book character of this work the short summaries and conclusions at the end of each chapter are of great advantage. The coloured pictures showing the symptoms of nutrient shortage are especially useful for those working in practice.

Author made the message of his work available for those not knowing French without translation by summarizing the content of each chapter in English and German on some 20 pages each at the end of the book.

The foreword of the book was written by Mr. P. Boischot, honorary director of the French agricultural research stations.

L. Gáspár

INDEX

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CHRONICA

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Printed in Hungary

A kiadásért felel az Akadémiai Kiadó igazgatója Műszaki szerkesztő: Farkas Sándor
A kézirat nyomdába érkezett: 1968. X. 24. – Terjedelem: 26,75 (A/5) ív, 108 ábra

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Dr. A. C. ZEVEN — Lawickse Allee 166, Wageningen
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Tomus XVIII

INDEX

Fasc. 1—2

VARIA

CHRONICA

RECENSIONES

Fasc. 3—4

VARIA

FORUM

CHRONICA

RECENSIONES

ACTA AGRONOMICA

ТОМ 18—ВЫП. 3—4

РЕЗЮМЕ

ОБРАЗОВАНИЕ ЛЕТУЧЕГО МАСЛА ДИФФЕРЕНЦИРУЮЩИМСЯ ЭПИДЕРМИСОМ РАСТУЩИХ ЛИСТЬЕВ *VALERIANA COLLINA* Wallr

Р. Г. СЕНТПЭТЭРИ, А. КОВАЧ, С. ШАРКАНЬ

В настоящей статье сообщается о выделении летучего масла протодермой листьев во время выполнения ею меристематической функции, а также о развитии железистых волосков и щетинок.

Согласно нашим микроскопическим наблюдениям летучее масло после кратковременного выделения, которое наблюдалось непосредственно в плазме, выделялось затем с поверхности плазмы через клеточную оболочку во внешнюю среду. Масло выделялось каждой клеткой (даже клетками стебля) с помощью различных типов железистых волосков. Дегенерация волосков начинается с клеток стебля.

КОЛИЧЕСТВЕННЫЙ ПЫЛЬЦЕВОЙ АНАЛИЗ ВЕНГЕРСКИХ МЕДОНОСОВ

М. АНДРАШФАЛВИ

Исследования были выполнены на пыльцевом спектре Robinia- (псевдоакация) и разных медоносов, происходящих из различных районов Венгрии. Пыльцевой спектр медоносов был уподоблён пчелиному пастбищу, которое было определёно пчеловодами. Кроме того, количественные исследования пыльцы были выполнены с помощью методов, описанных Maurizio и Demianowich, главным образом на образцах меда Robinia. Определение может быть более точным, если определяют приблизительный процент нектара Robinia в мёде, чем тогда, когда расчёты основаны просто на проценте участвовавшей пыльцы Robinia и других видов.

ВЛИЯНИЕ СПОСОБОВ ОПЫЛЕНИЯ НА ОПЛОДОТВОРЕНИЕ БАКЛАЖАНА

(Solanum melongena L.)

Дь. ПАЛ, М. ТАЛЛЕР

На баклажане в процессе опыления независимо друг от друга создается ход динамики завязывания плода (% завязывания) и оплодотворения семяпочек (число семян на плод). При минимальном завязывании мелких плодов возможно максимальное оплодотворение семяпочек и наоборот. Оба оптимума зависят от неодинаковых условий, поэтому и достигаются в неодинаковое время. Число семян в плоде зависит от метода опыления; при свободном опылении (само- и чужеопылении)их больше всего, при строгом самоопылении — меньше, а при строгом чужеопылении, — в зависимости от сорта и года, — меньше всего. Таким образом баклажан не облигатный, а факультативный самоопылитель. У сортов с длинным периодом цветения оптимум оплодотворения семяпочек наступает позже, а у сортов с коротким периодом цветения — раньше. При внутрисортовых скрещиваниях число семян в плоде значительно больше, чем при самоопылении и значительно меньше, чем при свободном опылении, а при межсортовом скрещивании меньше, чем при внутрисортовом.

ИЗУЧЕНИЕ ИЗМЕНЕНИЯ АКТИВНОСТИ ПЕРОКСИДАЗЫ В СОРТАХ PAPAVER SOMNIFERUM L. В ТЕЧЕНИЕ ОНТОГЕНЕЗА

Л. ФАРКАШ-РИЕДЕЛЬ

У 4-х сортов мака изучались активность пероксидазы и содержание морфина в тканях листьев и главных стеблей. Уровень пероксидазы и содержание морфина были также определены в коробочках в течение их созревания. Активность пероксидазы в коробочках следовала за максимальной кривой в течение развития коробочки. Максимальные показатели были достигнуты примерно через две недели после цветения. Содержание морфина также следовало за максимальной кривой, исключение составил сорт «Шопрони» уровень морфина которого оставался примерно постоянным после достижения плато В статье обсуждаются возможные корреляции между активностью пероксидазы, климатическими условиями и содержанием морфина.

УДОБРЕНИЕ СУДАНСКОЙ ТРАВЫ

Е. КЮКЭДИ

Здесь представлены отечественные и иностранные результаты по удобрению суданской травы, основанные на венгерских полевых экспериментах и на данных иностранной литературы. Выполненные исследования так же, как и литературные данные, показывают, что удобрения — особенно азот — заметно увеличивают урожай. Азотные удобрения, вносимые вместо навоза, более эффективны, чем сам навоз. Были получены отличные результаты при использовании половинной дозы (174 ц/га) навоза, дополненной эквивалентным количеством азотного удобрения. Дополнительно к эффекту повышения урожая, удобрения — прежде всего азотное — увеличивают содержание в суданской траве сырого протеина, а также HCN.

ОПТИМАЛЬНЫЙ СОСТАВ ЭМУЛЬЗИОННЫХ ЗАЩИТНЫХ СРЕДСТВ ДЛЯ РАСТЕНИЙ

К. МОНОШТОРИ, А. ТАНЧА

Статья обсуждает метод выбора оптимального состава готового средства защиты растений, иллюстрированный на примере активного агента 2,4-дихлоро-фенокси-уксусно-кисл.-октил эфира. Квалификация была основана на 24-часовой эмульсионной стабильности эмульсионного агента. Выбирая эмульгатор мы использовали растворы, содержащие от 2 до 4% эмульгатора. Наиболее подходящими для данного активного агента были ксилол, как растворитель, и Эмульсоген ИТ, как эмульгатор. Готовый продукт, содержащий три компонента, может быть рассмотрен как тройная система, поведение которой является функцией соотношения компонентов. Свойства, зависящие от соотношения компонентов, могут характеризоваться квантитативно путем графического изображения состава. Результаты наших измерений мы изобразили на диаграмме в виде треугольника, что представляет (2,4-дихлоро-феноксиуксусно-кисл.-октил эфир) — ксилол — Эмульсоген ИТ систему. Эта диаграмма дает точную информацию о составах, при которых наш эмульсионный продукт формирует стабильные эмульсии с водой.

МЕТОДЫ МЕЛИОРАЦИИ, РАЗРАБОТАННЫЕ ДЛЯ СОЛОНЦОВЫХ И СОЛОДОВЫХ ПОЧВ, УЧИТЫВАЮЩИЕ ПРОЦЕСС ИХ ОБРАЗОВАНИЯ

И. СОБОЛЬЧ

Солонцовые и солодовые почвы являются низкоплодородными и нуждаются в улучшении и мелиорации. Применяемые методы мелиорации различаются в зависимости от свойств почвы и условий внешней среды. На основании происхождения и свойств этих почв было выработано практическое группирование, которое подразделяет солонцовые и солодовые почвы на три группы в соответствии с их мелиорацией.

ИЗУЧЕНИЕ ДОПУСТИМОГО СОДЕРЖАНИЯ МОЧЕВИНЫ В ОВЦЕ

И. САБО

Автор изучил у овцы допустимое содержание мочевины и её продуктов, оказывающих тормозящее действие на развитие. 60 граммов мочевины из рубца овцы гидролизовали методом торможения. С этого времени чувствительность к мочевине у овец стала очень различной у разных особей, причём на второй день эксперимента одно из животных умерло. Установлено, что менее 60 граммов имеющейся смеси мочевины следует давать ежедневно овце, которая к этому ещё не привыкла. В результате гистологических исследований наметили только основу для получения дальнейших результатов.

ВЗАИМООТНОШЕНИЯ МАТОЧНОЙ ПОРОДЫ И ОКРУЖАЮЩЕЙ СРЕДЫ В ГЛИНИСТЫХ МИНЕРАЛАХ НЕКОТОРЫХ ПОЧВ ПЕРХУМИДСКОЙ ТРОПИЧЕСКОЙ ЗОНЫ

Б. ДАТТА

Изучали корреляцию между минералогическим составом глин, выделенных из двух индийских почв, на различных горных породах и из различных климатических зон с тем, чтобы отделить более грубые и попытаться объяснить механизм реакций, ведущих к образованию в них глинистых минералов под действием материала основной породы и климатических условий.

Исследование выявило, что ферромагниевые силикаты и слюды в мелком песке объединены в глине соответственно с Mg-образующими вторичными минералами (Pasighat) и иллитом (Cherrapunji). В случае когда глинистые минералы представляют собою магний-образующий тип 2 : 1 (Pasighat) или иллит (Cherrapunji) почвенный обменный комплекс содержит высокую пропорцию щелочных почвенных катионов, особенно Mg^{2+} и K^{+}, каждый из которых находится соответственно в динамическом равновесии с выветриванием щёлочи почв или с K-образующими первичными силикатами. Это объясняется стабильностью иллита в сильно щелочной и кислой почвах Cherrapunji. Стабильность была обеспечена высоким содержанием пригодных для обмена K^{+}, так как они всегда вновь пополнялись из разрушающихся K-образующих первичных минералов (muscovite), содержащихся в почве.

Non omnis moriar

It is with the deepest regret and grief that
the Editorial Board of the Acta Agronomica Academiae
Scientiarum Hungaricae announces the death of
member of our Editorial Board

DR. ERNŐ OBERMAYER

who passed away, after long suffering, on the 27th of
May, 1969 in the 81st year of his life.

The Editorial Board of
Acta Agronomica
Academiae Scientiarum Hungaricae

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VOLATILE OIL EXCRETION OF THE DIFFERENTIATING EPIDERMIS ON THE DEVELOPING LEAF OF VALERIANA COLLINA WALLR.

By

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DEPARTMENT OF APPLIED BOTANY AND HISTOGENESIS OF THE L. EÖTVÖS UNIVERSITY, BUDAPEST

The present paper reports on volatile oil excretion taking place at the time of meristematic function of the protoderm of leaves, as well as on the development of glandular hairs and bristles.

According to our light-microscopic studies, volatile oil is excreted — after a transitory excretion that has taken place within the plasm — from the plasm surface directly through the cell wall into the outside world. Oil is being excreted by every cell (even the stalk cell) of the various types of glandular hairs. The degeneration of the hairs starts from the stalk cell.

Introduction

In studying the question of excretion related to the function of meristems we have primarily examined on *Valeriana collina* Wallr. the formation of characteristic volatile oil bodies excreted in intracellular and continued way in the root and rhizome, respectively, with light- and electron-microscopic and histochemical methods being used (R. SZENTPÉTERY *et al.* 1965, 1966, 1967; SÁRKÁNY *et al.* 1966). Our present paper reports on our light-microscopic observations of transitory volatile oil excretion in developing leaves and shall be followed by another publication describing the pertaining electron-microscopic investigations.

Unlike the well-known volatile oil developing in the root of *Valerianaceae*, with its typical scent and used as drug, the volatile oil excreted in other parts of the plant and the oleaginous hairs have been scarcely treated in special literature. GUTTENBERG (1926) was the first to describe in some details the bristles of the fruit of *Valerianaceae*. METCALFE—CHALK (1950) range among the characteristics of the *Valerianaceae* the thick-walled and usually unicellular bristles as well as the glandular hairs composed of an unique multicellular stalk and a multicellular head. UPHOF—HUMMEL (1962) equally mention the glandular hairs of the *Valerianaceae*, with their head divided by horizontal and vertical partitions. Dealing primarily with volatile oil excretion of *Valeriana* roots, HOLZNER—LENDBRADL (1963) writes as follows: "Volatile oil can also be found in the environment of the shoot apex when it starts dividing. However, these are glands of epidermal nature, appearing on the leaf primordia of the shoot apex. Their formation seems to be very fast, since prestages can be hardly noticed."

Material and Method

Our studies on organizing leaves were accomplished in several periods. The first date was early in spring, at leaf organization following the melting of snow, the second in June, when the summer rosette leaves took shape after the inflorescence dried off, and the third in October, with autumn rosette leaves.

The test material was dissected under the stereomicroscope, the leaves and leaf primordia being examined in different stages of development. Our investigations ranged from the start of activity of the peripheral meristem, through the development of leaf segments to the maturation of leaf tissues. Part of our investigations were made on living untreated material, some of the material was studied without cuts, recovered in water, while another part was examined in manual longitudinal cuts. In our histochemical examinations we used an alkaline, toluidine blue — iodine double staining technique worked out and used for volatile oil studies in the root (R. Szentpétery 1967). The leaves and leaf primordia of different stages of development, being studied with light-microscope, were simultaneously fixed for electron-microscopic examination, too. The plasmolysis of oil-excreting cells was also studied and solubility tests were performed.

Results and Discussion

During a vigorous pleuroplast development of leaf primordia, while the midrib was developing, neither volatile oil nor its precursors could be traced. However, after the start of peripheral meristematic activity, creating the segmented leaf sheet and functioning according to three cellular rhythms, strongly refractive droplets appeared in the protoderm succeeding to peripheral growth with quick anticlinal divisions (Fig. 1). These refractive droplets—presumably the precursors—, reacted to toluidine-blue—iodine double staining (specific for volatile oils with unsaturated bonds) only with a pale yellow non-specific colour. According to our comparative solubility tests, the precursors of subsequently developing volatile oils presented stronger lipophillic properties, which is in opposition to the examinations of Paech (1952) on *Asarum* (Table 1).

Table 1

Solvent	Refractive droplets (precursors)	Volatile oil
96 per cent		
ethanol	5—10′	50—55′
ether	5—10′	20—25′
benzol	1— 2′	3— 5′
water	no dissolution	no dissolution

According to our histochemical and solubility tests we may thus regard the refractive droplets appearing in the protoderma of the *Valeriana* as the immediate precursors of volatile oil, where the unsaturated bonds producing the specific colour-reaction have presumably not yet developed.

In his electron-microscopic studies on the leaves of *Mentha piperita*, AMELUNXEN (1967) has found some differences between the precursors and the volatile oil both in osmiophilly and in fine structure. Equally electron-microscopic methods we are going to use for examining the precursors of the volatile oil of *Valeriana*.

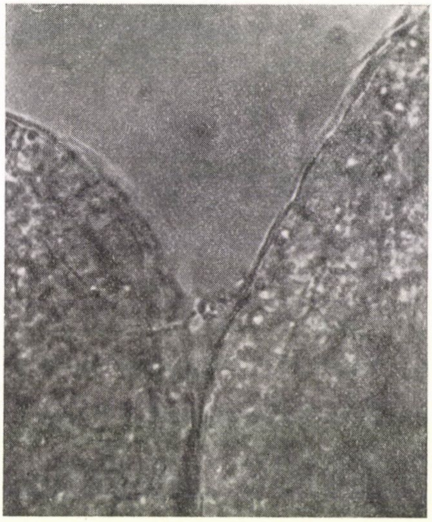

Fig. 1. Leaf primordium, top view. Precursor droplets in the protoderm. N = 40 × 6.3

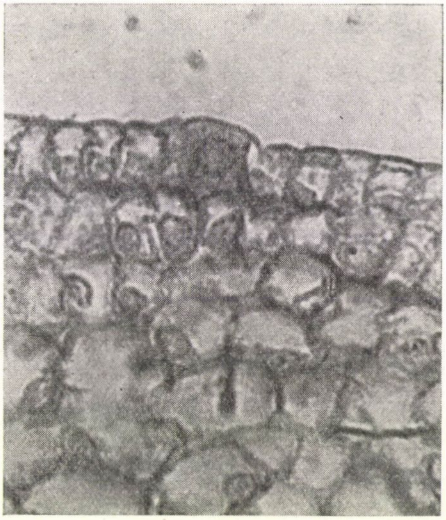

Fig. 2. Trichoblast cell in the protoderm of the leaf primordium, long. sect. N = 40 × 6.3

In his examinations of *Asarum*, PAECH (1952) has demonstrated strongly refractive particles, qualified as precursors, in the oil-bearing cells containing volatile oil droplets; these particles distinguished themselves from the oil droplets both in solubility and stainability. We must emphasize in this context, that the time when refractive droplets appear in the protoderm of *Valeriana*, there is no stainable volatile oil yet, and so, in the case of *Valeriana*, the appearance of precursors can be separated from the development of volatile oil.

During the organization of the protoderm, when the stoma mother-cells divide into two guard cells, large and strongly refractive trichoblast cells with large nuclei appear among the cells of the protoderm (Fig. 2). In these cells, as well as in the surrounding protoderm cells the volatile oil can be detected by means of double staining, so the vigorous reduction processes producing the unsaturated bonds have presumably taken place in the precursors.

As long as the divisions are taking place in the protoderm and the developing glandular hairs, these refractive precursor droplets can be detected together with already developed volatile oil yielding a specific colour reaction. Once the epidermis is mature, however, precursors disappear from the cells. This observation suggests the conclusion that, in regard to the leaf, the formation of volatile oil is explicitly correlated to meristematic function and determined thereby. In this respect there is a resemblance with the formation of the so-called calyptra oil-bodies of an entirely different morphological type and already detected in the root-tip of Valeriana, where the formation of the oil-bodies is correlated to the division of dermocalyptrogen and calyptra cells (R. SZENTPÉTERY *et al.* 1966). Volatile oil excretion connected with the functioning of meristems has actually been detected with several species (AMELUNXEN 1965; BANCHER—HÖLZL 1959; BRUCH 1955; HOLZNER—LENDBRADL 1963; PAECH 1952; SPRECHER 1956).

Fig. 3. Developing glandular hairs on the longitudinal section of the organizing leaf, droplet of volatile oil in the young epidermis. N = 40 × 6.3

The glandular hairs are formed most rapidly out of trichoblast cells; during their development the volatile oil can be detected practically in every cell of the dividing protoderm (Fig. 3). The first division of the trichoblast cells always takes place with a horizontal cell wall and is of inequal nature (Fig. 4). Some of the glandular hairs are divided during their entire development by horizontal cell walls only (Fig. 5), and so the glandular hair is composed of a unicellular sole-cell (elongating into a stalk cell) carrying a two-celled head divided by a horizontal wall (Fig. 6). There is also another type of glandular hairs which, after the first horizontal division of the trichoblast cell, is divided in the upper secondary cell by vertical cell walls, too (Fig. 7). Subsequently

Fig. 4. Leaf primordium, long. sect., trichoblast cell divided by horizontal cell walls. N = 40 × 6.3

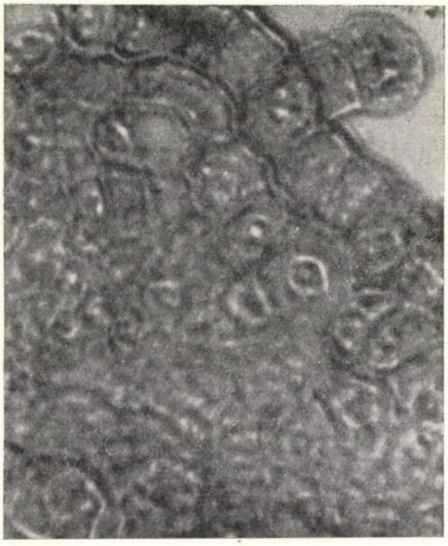

Fig. 5. Leaf primordium, long. sect., glandular hair primordium divided only by horizontal partitions. N = 40 × 6.3

the sub-apical cell is divided by both horizontal and vertical cell walls, and so the glandular hair is composed of a multicellular head carried by a unicellular stalk (Fig. 8).

In every cell of the dividing and developed glandular hairs there are stainable volatile oil and strongly refractive precursors to be observed (Fig. 9).

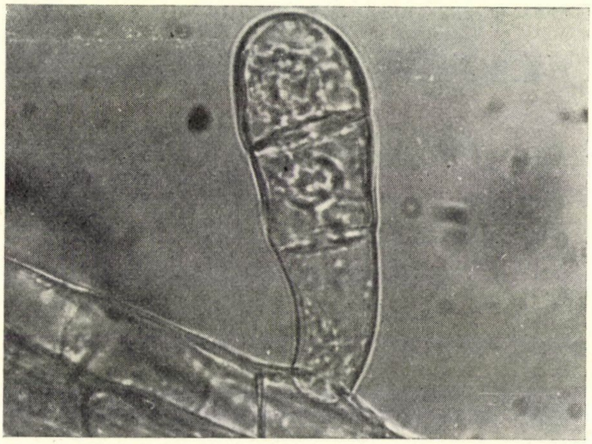

Fig. 6. Developing leaf, long. sect., glandular hair divided only by horizontal partitions. N = 40 × 6.3

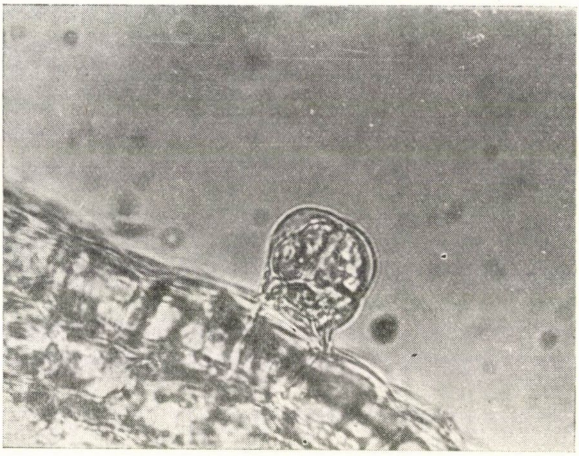

Fig. 7. Developing leaf, long. sect., glandular hair primordium divided by horizontal and vertical partitions. N = 40×6.3

According to our examinations, volatile oil is not delimited from plasm, excretion taking place from the plasm surface directly through the cellulose cell wall covered with the cuticle, into the external surface of the cuticle, i.e. into the outside world. We were unable to detect any ectodesms on the cell wall, so the volatile oil — similar to the lipoid building-stones of cutine (BOLLIGER 1959, 1960) — penetrates through the cell wall by means of passive diffusion and cuticular transpiration. Thus, in the peripheral lipoid membrane of the cell wall, there may be not only cutine and wax, but also resinified volatile oil accumulated (Fig. 9). After all, the volatile oil excretion of developing leaves is comparable to a form of what MAZURKIEWICZ (1913, cit. KISSER 1958) has

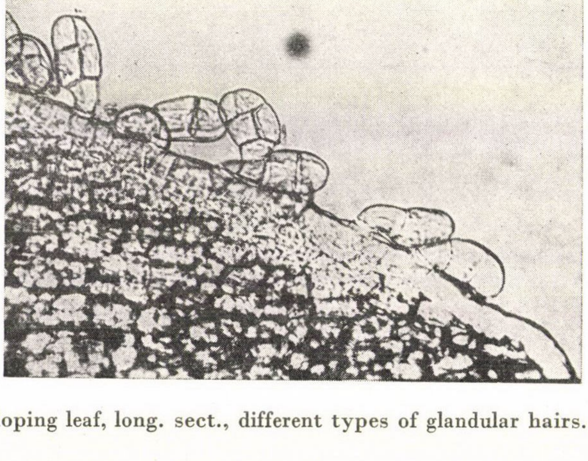

Fig. 8. Developing leaf, long. sect., different types of glandular hairs. N = 16×6.3

described as "temporary excretion", where there is no lasting reformation. In our following paper on the pertaining ultrastructural studies we are going to revert in details to the process of volatile oil excretion of *Valeriana* protoderm.

In the case of glandular hairs of *Valeriana*, the "Mittelzelle" as interpreted by SCHRÖDTER (1926) and KLUG (1926, cit. UPHOF 1962) does not develop. We again emphasize that volatile oil can be detected in every cell of the glandular hair, including the stalk cell. In this respect, we cannot speak about the excretory cells of glandular hairs, taken in the classical sense and usually referred to the cells of the head. It should be noted, however, that according to informative tests made on other species, we have generally found no separable "excretory cells" in the glandular hairs and so the general opinion as expressed in special literature and stating that the stalked glandular hair excrete the oil only in their head (KAUSSMANN 1963) must be by all means reconsidered.

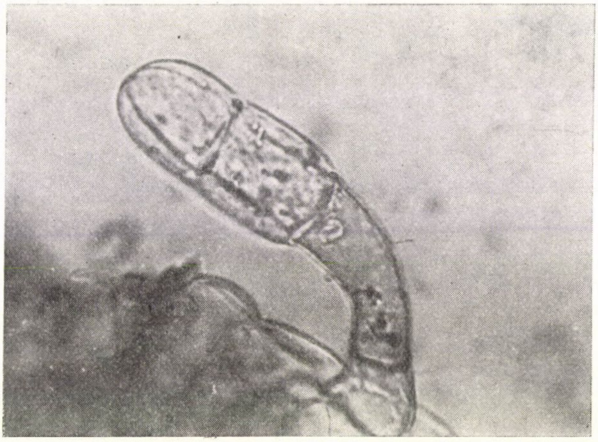

Fig. 9. Developing leaf, long. sect., volatile oil and precursor droplets in the glandular hair, resin particle excreted into the outside world, sitting on the cell wall (toluidine — iodine double staining). N = 40 × 6.3

TUNMANN (1926, cit. UPHOF 1962) has detected a central plasm bundle in the stalk cells of *Pelargonium* glandular hairs; a similar central plasm bundle was examined by SCHRÖDTER (1926) in glandular hairs of the *Cucurbitaceae*. In our examinations of *Valeriana* we have also found this central plasm bundle, but it reached not only through the stalk cell but as far as the apex of the glandular hair (Fig. 10). According to our observations, however, this central plasm bundle is not a "nutriyent-conveying bridge" (TUNMANN 1900, cit. UPHOF 1962), but the first sign of plasm degeneration in the hair. During the plasmolysis of glandular hairs with fully developed glandular bundles the latter is

Fig. 10. Developing leaf, long. sect., central plasm bundle extending from the sole cell to the apex of the glandular hair. N = 40 × 6.3

Fig. 11. Developing leaf, long. sect., plasmolysed glandular hair. N = 40 × 6.3

always discontinued in the stalk cell, while the formation of a characteristic plasm thread can be observed in the head cells (Fig. 11). Soon after the central plasm bundle has developed, the plasm of the stalk cell begins to degenerate (Fig. 9) and a subsequent plasm degeneration takes place in the cells of the head, too. Meanwhile the stalk cell is shrivelling (Fig. 12) and the glandular

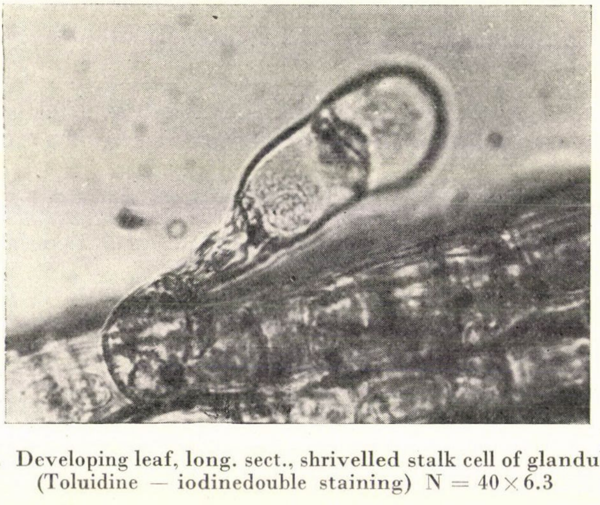

Fig. 12. Developing leaf, long. sect., shrivelled stalk cell of glandular hair. (Toluidine — iodinedouble staining) N = 40 × 6.3

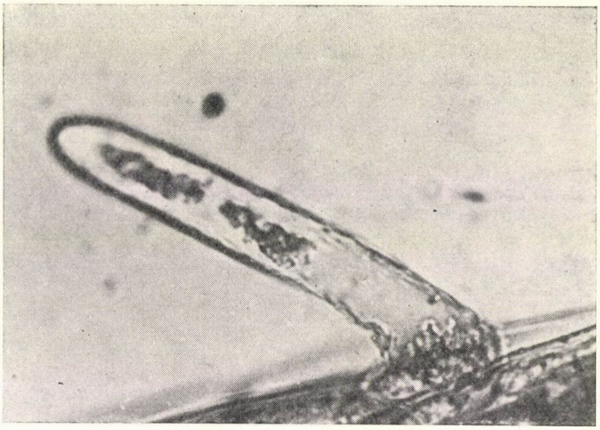

Fig. 13. Young leaf, volatile oil in the bristle still containing plasm. (Toluidine — iodine double staining) N = 40 × 6.3

hair dies off. The degeneration of *Valeriana* glandular hairs thus begins in the stalk cell and proceeds towards the apical or head cells. i.e. just in the opposite way as in the cases described by SCHRÖDTER (1926) and KLUG (1926, cit. UPHOF) where degeneration started always in the "excretory" cells, i.e. in those of the head, while the stalk cell was the last to degenerate.

When plasm degeneration begins in the stalk cell of *Valeriana collina*, there also begins the development of unicellular bristles in which volatile oil can as well be detected in their young age i.e. as long as they contain any plasm (Fig. 13). However, the cell wall of the bristles is being rapidly lignified, while their plasm gets necrotized (Fig. 14).

Volatile oil can be detected for the longest time in the epidermis cells, but disappears even from there when the leaf is fully developed.

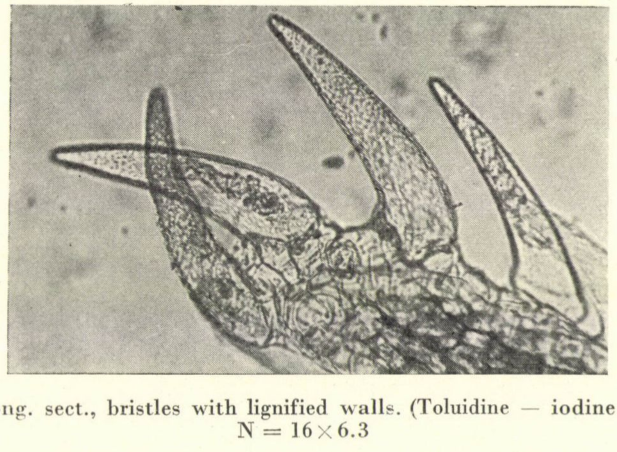

Fig. 14. Leaf, long. sect., bristles with lignified walls. (Toluidine — iodine double staining) N = 16 × 6.3

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QUANTITATIVE POLLEN ANALYSES OF HUNGARIAN HONEYS

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Investigations have been carried out into the pollen spectrum of *Robinia*-(locust) and mixed flower honeys originating from various regions of Hungary. The pollen spectrum of the honeys has been compared to the pasture of bees indicated by the apiculturists. Moreover, quantitative pollen studies have been carried out applying methods described by Maurizio and Demianowicz mainly on *Robinia* honey samples. Qualification may be more correct by determining the approximate percentage of *Robinia* nectar in the honey than if it is based simply on percentage of pollen contributed by Robinia and other species.

Introduction

Many authors have dealt with the pollen analysis of honey. Their investigations were primarily of qualitative character (ARMBRUSTER—OENICKE 1929, ZANDER 1935, 1937, HAZSLINSZKY 1952, MAURIZIO—LOUVEAUX 1965). Qualitative examination of pollens occurring in honeys offers many unsolved problems even today (LOUVEAUX 1961), since the variety of pollen forms is almost innumerable. In this respect ZANDER's (1935) comprehensive work — which gives a good method of making preparations for pollen studies and treats the pollenmorphology and measurement in taxonomic order — is very important.

However, a knowledge concerning the qualitative composition of honeys does not — in most cases — offer a true picture of their nectar composition; hence the method used in practice of counting out 100 pollens and determining the percentage composition from them has not proved to be satisfactory in this respect. Therefore, a quantitative method disclosing — or at least approaching — the true origin of honeys had to be chosen. It is this that MAURIZIO's (1939, 1949, 1955) research work was aimed at. She has made comprehensive quantitative and qualitative pollen studies and published detailed data in a number of papers on the basis of examining many honey samples. Consequently, precise prescription has been developed concerning the quantitative evaluation of the microscopic pollen-scores of honeys. Besides the number of pollens MAURIZIO (1939) gives the total number of plant components including cells of algae and spores of fungi. She divides the honeys into 3 groups according to the total number of particles originating from plants per 10 gram of honey:

Group I. less than 20.000
Group II. 20.000–100.000
Group III. 100.000 and more.

Within one group honeys can be compared to each other, since the number of pollens per unit nectar is closely similar. MAURIZIO's (1949) definitions of "leading pollen" (Leitpollen) at a ratio of 45 per cent, "accompanying pollen" (Begleitpollen) at 16–45 per cent and "single pollen" (Einzelpollen) below 16 per cent stand for honeys belonging to Group II. In the case of honeys belonging to Groups I and III these percentage values need to be corrected, as honeys in Group I are extremely poor in pollen, while those of Group III are rich in pollen, which means that the composition of the nectar is not proportional with that of the pollen. Accordingly, *Robinia* honey can be considered to be pure over 40 per cent and the honey originating from linden flowers above 35–40 per cent, because these flowers produce relatively few pollens but much nectar, thus in spite of its low pollen percentage the nectar of the respective plant may predominate in the honey. On the other hand, the honey of *Myosotis*, which produces an abundance of pollens i.e. belongs to Group III can be considered as pure *Myosotis* honey only when its pollen ratio is at least 70 per cent.

In Hungary pollen studies were made by HAZSLINSZKY (1938, 1952, 1955) on various – mainly *Robinia* – honeys. According to his procedure 500 pollens have to be counted and classified in each sample, then leading, accompanying and single pollens have to be determined. He considered MAURIZIO's method to be too lenghty for being used in mass examinations.

HAZSLINSZKY also dealt with the mechanism of granulation and suggested that dextrin-like substances produced by the decomposition of saccharose delayed granulation in mellow honeys. On the other hand, granulating tendency of raw honeys is stronger, and honeys containing mainly glucose crystallize earlier than those containing more fructose. The slow crystallization observed in *Robinia* honeys may be the consequence of the latter fact (*Robinia* honeys may stay liquid even for several years).

According to the examinations of HAZSLINSZKY, reasons of flowering-biological nature support the fact that the *Robinia* pollen ratio of *Robinia* honeys is low, whereas its nectar ratio is high. On the other hand, certain pollens (e.g. those of *Verbascum* and *Cruciferae*) are represented in a relatively high percentage, because the flowers of these plants produce pollen in abundance and are more easily available for bees, than those of the *Robinia* flowers. Meanwhile they produce little – or hardly any – nectar. It is very important to consider the circumstances mentioned in order to be able to form an idea of the true composition of honey. Thus, ratio of *Robinia* pollen calculated in honey samples should be corrected upwards, while that of e.g. *Cruciferae* and *Verbascum* downwards. At the end of his study on *Robinia* honeys HAZSLINSZKY (1952) suggested to make corrections with *Robinia* and other types of honey, corrections based on observation of the individual species whether they produce more pollen and less nectar or inversely. The solution of this problem is being pushed on by DEMIANOWICZ—JABLONSKI (1960) and DEMIANOWICZ (1961). They have produced specific honeys by isolating beehives in cages forcing them to collect nectar from flowers of the single species offered. Pollen counts of these specific honeys according to MAURIZIO's method were referred to 1 g honey. 27 different specific honeys were examined in this way and results of the pollen counts were arranged in a Table. Thus, the pollen-coefficient is an average number of pollen in 1 g of honey of the respective plant species. Unbiased estimates of the nectar composition of individual honeys may be obtained by means of these pollen-coefficients DEMIANOWICZ (1962). In addition to introducing the pollen-coefficient, DEMIANOWICZ has simplified MAURIZIO's counting method as well.

In this study results of comparative examinations, of several — mainly *Robinia* — honeys, are described, and discussed in order to apply the methods reviewed above for Hungarian conditions.

Material and Methods

So far as many as 30 honey samples have been examined both from qualitative and quantitative points of view, out of which detailed analyses of 17 samples are presented here. In 1965 and 1966 13 samples were sent by The Center of National Cooperation of Apiculturists (Országos Méhészeti Szövetkezeti Központ) for the purpose of testing the methods and performing preliminary examinations. These samples were *Robinia*-honeys and various mixed flower honeys originating from different regions of the country. In the summer of 1966 we obtained *Robinia* and mixed flower honeys from reliable, registered apiculturists.

MAURIZIO (1939) employed a quantitative counting method used for the bacteria-counts in milk and described by Breed. In the present examinations this method — with some minor alterations — was applied to the first 13 samples. Maurizio started with a watery honey dilution of 50 percent, centrifuged for 5 minutes at 2.500 r.p.m. then discharged to 5ml, and centrifuged again in a 10 ml graduated tube. After being discharged it is filled up to 5 ml, and a 1 cm^2 surface is smeared over with 0.01 ml (corresponding with 1 g honey) of this residue with the aid of a small pipette. This method has been altered to an extent of increasing the time of centrifuging to 10 minutes and using a 25 per cent solution instead of a 50 per cent one, because, according to our experience, the rate of precipitation of particles is much higher at this lower concentration. Smears of 1 square cm magnified 300 times were counted with a reticular eyepiece under a Zeiss binocular microscope. The reticle employed in the ocular is divided into 100 large squares with 400 small squares within them. In the course of our examinations we counted the pollens in 100 visual fields (1 visual field = 25 large squares = 100 small squares). We summarized the partial results in Tables, according to MAURIZIO's method, and by calculating means we obtained the factor "F" characterizing the pollen content of honeys. Data of the honey providing the pollen-numbers of Table 1 are the following: Place of extraction: Egyházasgerge; time of extraction: 1965 June 21st; source: *Robinia* S. Solty. In the last column is the "F"-value of this honey i.e. 1.30.

As the pollen content of 10 g honey is required, we need the number of visual fields included in 1 cm^2. (We have determined the side-length of small squares in the reticle used by us = 40.5 micron; accordingly, the area of 1 visual field is equal to that of 100 squares = 0.00164025 cm^2; $\frac{1\ \text{cm}^2}{0.00164025} = 609.6$.) Hence, 1 cm^2 includes 609.6 visual fields. The absolute

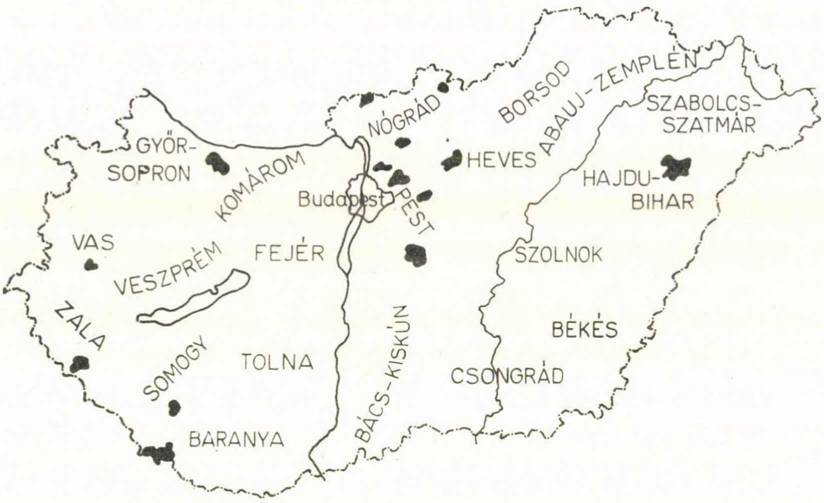

Fig. 1. The black spots on the map indicate the sites of origin of honey samples examined. (Circumscribed areas are the outskirts of villages.)

pollen content of 10 g honey is 609.6 × 10 × F. In the above example 10 g honey contains: 609.6 × 10 × 1.30 = 7925 pollens.

Demianowicz's (1961) method is quicker and more suitable for mass examinations. It is based on — and is a simplified form of — Maurizio's method. Here, instead of 100 visual fields the pollens within the stripes of the preparation are counted with the aid of the reticle. The width of a stripe corresponds to the side-length of 5 small squares. As we know the size of the squares, we know that the area of a stripe is 2.25 mm^2. Thus, in 1 cm^2 there are 44.4 stripes. According to Demianowicz's method, in honeys with a high pollen content pollens have to be counted in 2 stripes, in those with a medium pollen content in 4, and in honeys poor in pollen in 8 stripes. Pollen numbers obtained in this way are converted into 1 cm^2 and given for 1 g honey. In addition to the absolute total number of pollens, absolute values can be obtained for the individual pollen species. With the aid of these values as well as of the pollen coefficient characteristic of each pollen species, percentage nectar proportion of the respective plant as

Table 1

Data obtained by Maurizio method of pollen counts in the honey sample referred to as an example
(S. Solty, Egyházasgerge)

Smears	Visual fields	Number of pollens per visual field								Mean value
		0	1	2	3	4	5	6	7	
1. I/1	100	22	42	29	5	1	1	—	—	1.24
2. I/2	100	23	31	32	9	4	1	—	—	1.43
3. II/1	100	22	38	25	10	3	1	—	1	1.42
4. II/2	100	29	44	18	6	2	1	—	—	1.11
5. I/1+2	200									1.33
6. II/1+2	200									1.26
7. I+II	400									1.30

found in the honey is calculated by the formula:

$$m_x = \frac{P_x \cdot 100}{K_x}$$

where m_x = nectar percentage; P_x = absolut pollen content of the species "X" in 1 g honey; K_x = coefficient of the class that X-honey belongs to. In some cases corrections had to be made. Namely, pollens are highly concentrated in the middle, while often hardly existing at the edges of the smear.

Data of the 17 samples mentioned were obtained by this method with pollen-coefficients used.

Results and Discussion

Qualitative and quantitative results as well as other data are presented in Table 2. Pollen-coefficients used are the following: ***Robinia pseudoacacia*** K = 112,5; ***Trifolium repens*** K = 1800; ***Onobrychis viciaefolia*** K = 1800; ***Stachys*** K = 900 (arbitrary value); ***Carduus*** K = 3600; ***Cruciferae (Brassica napus)*** K = 7200. Percentage values obtained by the above method indicate the nectar composition. Besides, percentage pollen composition of all the 17 honey samples is also given on the basis of counting out 100 pollens: a method generally used so far in practice.

Out of the samples those of No. 20, 31, 57, 58, 64, 69 and 77 were designated as ***Robinia*** honeys, which proved to be true by our examinations. In these honeys the amount of ***Robinia*** pollen ranges between 62 and 90 per cent, while the proportion of ***Robinia*** nectar is 80—99 per cent, i.e. they are considered to be practically pure ***Robinia*** honeys. All these honeys were extracted in May and early June. It is known that in 1966 owing to the favourable weather in May the flowering of ***Robinia*** trees had been finished by the beginning of June even in the most northern part of Hungary.

Sample No. 29 was sent in as ***Robinia-Onobrychis*** honey. Indeed these two kinds of pollen dominate in the honey sample and the composition of both pollen and nectar is of strong ***Robinia*** character. Samples No. 9/1 and 9/2 are of a much weaker ***Robinia*** character, though — according to their sender — ***Robinia*** honey of No. 9/1 was extracted from intact honeycombs and No. 9/2 from a honeycomb more than one year old, containing pollens. In both samples there is a considerable amount of red clover, and the 30—40 per cent proportion of ***Robinia*** nectar does not justify their labelling as Robinia honeys at all.

Samples No. 9/3, 17 and 78 were sent in as mixed flower honeys. Sample 9/3 is a mixed flower honey extracted in July, with a considerable red clover ***(Trifolium pratense)*** and ***Onobrychis*** content; it granulates poorly due partly to its nectar content originating from other plants (e.g. ***Stachys***). Sample No. 17 sent in from southern Hungary as ***Robinia***-red clover-cornflower honey extracted at the end of May, is problematical. Its qualitative pollen composi-

Table 2

Percentage pollen content of the 17 samples examined, nectar percentage determined by Demianowicz's method and other data

Sample	Name: Time of extr. Place of extr.	Qualitative pollen picture	Quantitative results determined by Demianowicz's method (nectar)	Percentage results obtained by counting out 100 pollens; a method used in practice (pollen)	Notes
9/1	J. Mester Becsehely	*Trifolium pratense, Robinia, Onobrychis, Centaurea, Caryophyllaceae, Umbelliferae,*	5.5% *Trifolium* 30 % *Robinia*	40% *Trifolium* 24% *Robinia*	Sent in as *Robinia* honey extracted from intact honeycombs
9/2	J. Mester Becsehely	*Trifolium pratense, Robinia, Centaurea, Onobrychis, Caryophyllaceae, Umbelliferae, Cruciferae,*	7 % *Trifolium* 34 % *Robinia*	49% *Trifolium* 24% *Robinia*	Sent in as *Robinia* honey extracted from more than one year old honeycombs containing pollens
9/3	J. Mester Becsehely 1966 July	*Trifolium pratense, Onobrychis, Stachys, Castanea, Centaurea, Caryophyllaceae, Umbelliferae, Cruciferae,*	5 % *Trifolium* 3 % *Onobrychis*	23% *Trifolium* 14% *Onobrychis*	Sent in as flower honey extracted the second time in the middle of July 1966. It granulates
17	L. Szőke 1966 May 21st Középrigóc (near to Barcs)	*Robinia, Trifolium pratense, Centaurea, Cruciferae, Gramineae,*	93 % *Robinia* 1.2% *Trifolium*	70% *Robinia* 5% *Trifolium*	Sent in as a mixed honey of *Robinia*, red clover and cornflower. Crystallized honey
20	J. Máté May 29th 1966 Drégelypalánk	*Robinia, Cruciferae, Rosaceae, Lotus, Gramineae, Centaurea,*	80 % *Robinia* 0.5% *Cruciferae*	62% *Robinia* 16% *Cruciferae*	Sent in as *Robinia* honey
29	G. Kovács 6th June 1966 Bönyrétalap	*Robinia, Onobrychis,* other *Leguminosae, Vicia, Cruciferae,*	68 % *Robinia* 4 % *Onobrychis*	52% *Robinia* 17% *Onobrychis*	Sent in as a mixed honey of *Robinia* and *Onobrychis*
31	J. Dékány 23rd May 1966. Kóka	*Robinia, Gramineae Chenopodium, Salix, Vicia, Caryophyllaceae, Cruciferae,*	98 % *Robinia*	70% *Robinia*	Sent in as *Robinia* honey

41	P. Soltész 26th June 1966 Csomád	*Stachys, Cruciferae Robinia, Centaurea, Caryophyllaceae, Cirsium*	5 % *Stachys* 19 % *Robinia*	41% *Stachys* 7% *Robinia*	Sent in as *Robinia* honey. It granulates
52	L. Guba 23rd May 1966 Acsa	*Robinia, Cruciferae, Caryophyllaceae, Onobrychis, Centaurea, Umbelliferae,*	58 % *Robinia* 3 % *Cruciferae*	45% *Robinia* 12% *Cruciferae*	Sent in as *Robinia* honey. Slightly granulating
54	B. Borsos 22nd May 1966 Mike	*Robinia, Stachys, Trifolium, Caryophyllaceae Onobrychis, Centaurea, Lotus, Gramineae,*	96 % *Robinia* 3 % *Stachys* 0.5% *Trifolium*	58% *Robinia* 26% *Stachys* 3% *Trifolium*	Sent in as *Robinia* honey from the first, stimulating extraction. Crystallized honey
57	S. Pörös 18th May 1966 Mike	*Robinia, Trifolium, Cruciferae, Gramineae, Onobrychis,*	98 % *Robinia* 1.8% *Trifolium*	63% *Robinia* 10% *Trifolium*	Sent in as Robinia honey
58	Gy. Nyári 30th May 1966 Pácsony	*Robinia, Cruciferae, Trifolium pratense, Rosaceae, Gramineae, Lotus,*	98 % *Robinia* 1.2% *Cruciferae* 0.6% *Trifolium*	65% *Robinia* 23% *Cruciferae* 10% *Trifolium*	Sent in as a mixed honey of *Robinia* and hairy vetch
64	L. Kasuba 16th May 1966 Forest of Pusztavacs	*Robinia, Gramineae, Carex,*	99 % *Robinia*	80% *Robinia*	Sent in as *Robinia* honey
67	J. Fekete 20th June 1966 Hajduhadház	*Robinia, Stachys, Caryophyllaceae, Helianthus, Gramineae,*	90 % *Robinia* 4.5% *Stachys*	55% *Robinia* 26% *Stachys*	Sent in as *Robinia* honey. Granulating
69	J. Szarvas 4—5th June 1966 Etes	*Robinia, Salix, Trifolium, Rosaceae, Gramineae, Caryophyllaceae*	99 % *Robinia*	83% *Robinia*	Sent in as *Robinia* honey
77	J. Suhayda May 1966 Gödöllő	*Robinia, Rosaceae, Cruciferae, Caryophyllaceae, Pinus,*	99 % *Robinia* 0.6% *Cruciferae*	90% *Robinia* 9% *Cruciferae*	Sent in as *Robinia* honey
78	J. Suhayda August 1966 Hort	*Stachys, Carduus, Cruciferae, Taraxacum, Zea, Trifolium*	59 % *Stachys* 4 % *Cruciferae* 0.7% *Carduus*	68% *Stachys* 27% *Cruciferae* 5% *Carduus*	Sent in as a mixed honey of *Stachys* and sunflower. *(Helianthus)* Crystallized

Note: with the above percentage values a possible error of about 5 percent should be counted on.

tion conforms with its labelling. However, in its nectar composition *Robinia* predominates to such an extent that it would not be incorrect to take it as *Robinia* honey providing the percentage of nectar is considered. But the honey is granulated which does not conform with the *Robinia* character. The presence of nectar collected from red clover, cornflower and other plants and amounting to a total of 7 per cent was supposedly enough to start the process of crystallization. Sample No. 78 is a typical summer honey run in August. It was sent in as a mixed flower honey of *Stachys* and sunflower *(Helianthus)*. There is indeed a high proportion of *Stachys* in it, while no sunflower, but other *Compositae (Carduus* and *Taraxacum)* were found in it. The honey characteristically of the *Stachys* honey was completely granulated in a short time.

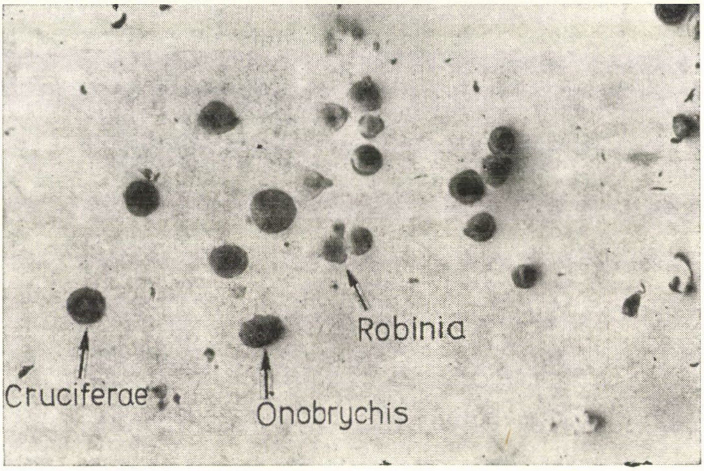

Fig. 2. Pollens of *Robinia*, Cruciferae and *Onobrychis* in sample No. 52. (Photo of a dry preparation (smear) magnified 300 times.)

We have to be very careful when judging samples No. 41, 52, 54 and 67. All the four samples were sent in as *Robinia* honeys. In the case of sample No. 41 this is almost impossible, if only because of the time of extraction (June 26th). This sample is a typical mixed flower honey, it granulates, *Stachys* is present and the proportion of *Robinia* is low in it. While after the proportion of *Robinia* nectar sample No. 52 could be qualified as a honey of *Robinia* character, its *Robinia* character is not, however, unambiguous owing to its granulating tendency. Sample No. 67 was run at the end of June; besides a high content of *Robinia* nectar, *Stachys* and sunflower are also represented in it. Sample No. 54 is of high *Robinia* nectar content, but *Stachys*, red clover and *Onobrychis*, too, are simultaneously represented in it. The honey was run at the end of May, how is it possible that it contains *Stachys*? The label reads: "The sample is taken from the first, stimulating extraction, from the upper third part of a 200 kg barrel. It is not an average sample." It is highly probable that some partially crystallized honey left over in the bee-hive from the previous year had been extracted together with the last three samples and started the granulation. In sample No. 54 — as it is from the first, stimulating extraction — granulation may have been quickened by the rawness of the honey.

In general, our results indicate that with 35—60 per cent *Robinia*-pollen present, the honey contains practically pure *Robinia* nectar (80—98 per cent) and with a *Robinia* pollen content of 30—35 per cent *Robinia* character can be spoken of, because in this case the honey contains 50—60 per cent *Robinia* nectar (MAURIZIO 1949, HAZSLINSZKY 1952). Individual qualifications of the 17 honey samples suggest, however, that these observations may often prove false, because, when qualifying, not only the pollen content and nectar content respectively, but also accompanying pollens and other features of the honey (e.g. granulating tendency) as well as the place and time of running should be taken into consideration in order to be able to form a true picture of the honey that had been labelled in good faith by the apiculturist as quite different from what it really was.

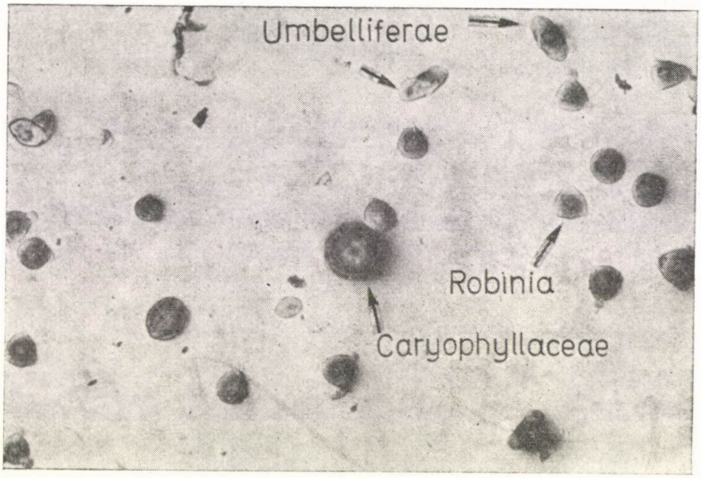

Fig. 3. Pollens of *Robinia*, *Umbelliferae* and carnations in sample No. 52. (Photo of a dry preparation (smear) magnified 300 times.)

Conclusions

Qualitative and quantitative comparative pollen analyses have been carried out with Hungarian honey samples. Majority of the samples was sent by the apiculturists as *Robinia* honey. We aimed at comparing the pollen scores of honey samples to the pastures of bees named by the apiculturists. Percentage distribution of the different pollens cannot be directly used for determining the source of the nectar. This is especially true of Hungarian *Robinia* honeys, it was, therefore, necessary to find an adequate method of estimation. The above methods have been applied to the Hungarian honeys. In Table 2 percentage data of simple pollen counts are compared with results obtained by the pollen-coefficient method of Demianowicz.

Results of the present study suggest that honeys containing 55—60 per cent *Robinia* pollen can be practically considered as pure *Robinia* honeys. If this proportion is 30—35 per cent, the sample is considered to be of *Robinia* character provided that accompanying pollens, physical and chemical features as well as place and time of extraction have also been taken into account. Results of the present study may be helpful in the dilemma of deciding whether a honey is of "*Robinia* character" or not.

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EFFECTS OF POLLINATION METHODS ON FERTILIZATION IN EGG-PLANT (SOLANUM MELONGENA L.)

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In egg-plant fruit-set (percentage of fruit-set) and primordial seed fertilization (number of seeds in fruits) develop independently of each other after pollination. With minimum fruit-set maximum primordial seed fertilization and vice versa may occur. The two optimums do not depend on identical conditions, thus do not take place at the same time either. The number of seeds in fruits depends on the method of pollination; it is the highest in case of free pollination (combined self- and cross pollination), somewhat lower in selfed plants and the lowest — depending on variety and year — in case of exclusive cross pollination. Thus egg-plants are not obligate but facultative self-pollinating plants. In varieties of prolongated flowering period optimum primordial seed fertilization takes place later, while in those with a shorter flowering period earlier. In intravarietal crosses the number of seeds in fruits is considerably higher than in selfed plants and substantially lower than in free pollinated plants; while in intervarietal crosses it is lower than in intravarietal crosses.

Introduction

The basic problems of the different pollination methods, the effects of the age of the stigma, emasculation and isolation have been studied in various plants from different aspects.

Within the effects by the age of the stigma the developmental process of the stigma was studied by USTINOVA (1962), WAGNER (1956); duration of fertility in the stigma by MÜLLER—SCHILOVA (1959), USTINOVA (1964), WILLIAMS (1965); optimum time of fertilization of the stigma by BIENZ (1958), DIACONU (1962), ELITROPI (1958), HALLAUER—SEARS (1966), HODZHIMURADOVA (1965), KOVACIK—HOLIENKA (1963), MURABAA (1957), ROSS—WEBSTER (1959), SHTSELOKOVA (1958), TKATSHENKO (1958), WANG MAO-HUA *et al.* (1959); effect of the age of the stigma on the extent of fertilization by SHTSELOKOVA (1960), RAJKI (1961), RIZEI (1958); on dominant inheritance of paternal and maternal features by AIZENSHTAT (1957), BATIKYAN—CHOLOHYAN (1958, 1961), CHENGTE (1964), SOKOLOVA (1965, 1966), TEMKIN (1963); on the ratio between male and female individuals in the offspring of dioecious plants by LASKOWSKA (1961), and on crossing ability by NEW (1965).

Removal of the male sexual organs of flowers, i.e. emasculation has — according to the investigations — a negative effect on the extent of seed set in crossing (DEMISOVA 1960), while in other varieties this phenomenon has not been observed (Rajki 1968). In primordial seeds invertase activity is reduced (Volodin 1956), namely emasculation inhibits the growth of the stigma (Linskens 1964), as well as — before and immediately after meiosis — the development of the gametophyton generation.

Isolation of emasculated flowers also decreases the extent of seed-set in certain species and varieties (Makaseva 1962), while in others not (Rajki 1968). Besides, isolation may result in parthenocarpic fruits in many plants (Mladentseva 1963).

In the course of studies on the methods of pollination it was found that with cross pollination the extent of seed-set was higher (Martianova 1967, Kovac—Boskovic 1963, Mlyniec 1962); the process of fertilization was more rapid (Mutafyan 1965), but the development of the embryo and endosperm was independent of the method of pollination (Woiciechowska 1963). Besides, seeds originating from cross pollination were larger (Brandenburg 1961). With cross pollination the amino acid content of the stigma decreases (Linskens 1966); P metabolism of the pistil (Vozda 1960), CO_2 assimilation and even CO_2 uptake by the leaves of the progeny (Dorohov 1964) depend on the method of pollination. Self-pollination has an unfavourable effect on the grain yield, germinating ability and viability of the progeny (Landovsky 1958) as well as on the course of the fertilization process, but the disorders observed at this phase in the endosperm do not determine self sterility (Hudyak 1959). With self-pollination the extent of seed-set, with cross pollination the effect of alien pollens are results of complex factors (quantity and quality of pollens, viability of the stigma, variety, alien pollens applied, year) (Hablo 1962). There are, however, plants (poppy) in the flowers of which before flowering partial self-pollination, after flowering cross pollination occur (Sárkány 1954).

Recently self-pollination and cross pollination are considered to be the results of the selectivity of the stigma, that is, some varieties give preference to the pollens of certain other varieties. Namely, in heterostyl plants (adapted to cross pollination) combined application of own and alien pollens proved to be more efficient than alien pollens applied alone (Polyakov—Chingo-Chingas 1958). On the other hand, self-pollinating plants — which are considered as the forms of effective adaptation to life conditions during evolution (Bálint—Kovács 1958) — prefer the pollens of certain varieties to theirs (Toskov 1957). This statement seems to be confirmed by the intensity of P^{32} accumulation in the pistil which depends on the pollen variety (Lyu Da-Czyun 1959). Namely, the pollens preferred by the seed plant at pollination cause maximum P^{32} accumulation at the same time.

Materials and Methods

The egg-plant-*Solanum melongena* L. — was the plant chosen for our investigations. Within the *Solanum melongena* L. species we studied 5 varieties which — according to FILOV's taxonomic system (1958) — were the following: S. *melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil., S. *melongena* L. ssp. *subspontaneum* Fil., var. *leucoum* Alef., S. *melongena* L. ssp. *orientale* Fil., var. *pecinense* Fil. and S. *melongena* L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil.

The egg-plant has polycarpic and polyspermic fruits, therefore it is an excellent test plant to study the different pollination methods on, unlike monospermic fruits developed from monocarpic and polycarpic gynoeceums; namely, in polyspermic fruits, besides fruit-set percentage, certain effects can be more precisely demonstrated by determining the number of seeds in fruits.

Our investigations were carried out in the field partly in 1962 and 1963, and partly in the years between 1962 and 1965. The following pollination methods were applied:

a) pollination at different developmental stages of the stigma (duration of fertility of the stigma). Flowers were emasculated on the same dates and pollinated at three-day intervals with pollen of the same variety, then isolated.

b) space isolation (free pollination = self-+ cross pollination). Flowers of the varieties were neither emasculated nor isolated.

c) isolation without emasculation (self-pollination). The flowers in bud stage were isolated with cellophane.

d) emasculation without isolation (exclusive cross pollination). The flowers in bud stage were emasculated but not isolated, only marked with labels.

e) intravarietal crossing (artificial cross pollination). Flowers were emasculated, pollinated with the same variety, then isolated.

f) inter-varietal crossing (artificial cross pollination). After being emasculated the flowers were pollinated with pollen of another variety, then isolated.

The examinations were replicated each year, with 50 flowers per combination. Fruit development took place beneath isolators. Ripe fruits were removed and the rate of fruit-set, i.e. the percentage of fruits developed from the pollinated flowers, was determined. The fruits were processed and the extent of fertilization — i.e. the number of seeds in fruits — determined. Our investigations were extended to the following questions: Trend in the rate of seedset and number of seeds in fruits

1. at different developmental stages of the stigma,
2. with natural pollination and
3. with artificial pollination.

Results

According to fertility of the stigma and the way pollens get onto the stigma our investigations and their results can be divided into three groups.

1. *Pollination performed at different developmental stages of the stigma.* Fruit-set and the primordial seed fertilization develop independently of each other. That is, maximum primordial seed fertilization (number of seeds in fruits) do occur with minimum fruit-set (fruit-set percentage) and vice versa too. This means that the two optimums do not depend on identical conditions, thus do not take place at the same time either. In our opinion polycarpic and monocarpic plants with monospermic fruits are not suitable for exact evaluation of the various pollination methods. Hence it is the number of seeds in fruits — i.e. primordial seed fertilization — and not the values of fruit-set which we consider to be the measure of fertilization in polyspermic plants.

Fertility of primordial seeds changes according to an optimum curve depending on the age of the stigma, that is, at a certain stage of development fertilization is of higher extent than either before or after. Our results obtained from pollinating at different developmental stages of the stigma are included in Table 1. Data of Table 1 show that the number of seeds in fruits of *Solanum melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil. is the highest when pollination is carried out on the 6th day after emasculation, while for *S. melongena* L. ssp. *subspontaneum* Fil., var. *leucoum* Alef. this interval is 3 days only. This agrees with our results obtained in determining the extent of the flowering period, namely, in the former variety the duration of flowering is longer than in the latter. This means that fertility optimum too develops later.

Table 1

Number of seeds in fruits when pollinating on different days after emasculation. 1962—1963

Variety	Number of days from emasculation to pollination	Fruit set percentage	Number of seeds in fruits
Solanum melongena L. ssp. *occidentale* Haz. var. *bulgaricum*	0	68.60	524.33
	3	100.00	1077.00
	6	62.20	1440.66
	9	60.00	726.16
Solanum melongena L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.	0	82.00	530.00
	3	100.00	765.80
	6	100.00	581.20

2. *Natural pollination.* By the term "natural pollination" the pollinating methods are meant in which pollens are carried onto the stigma with outer help (by wind, water, animals) or without (self-pollination), but by all means without deliberate or accidental human intervention.

a) *Free pollination* (self- + mutual pollination). Plants were neither emasculated nor isolated, only the flowers were labelled. Pollination may have been self-pollination (autogamy) and both cases of mutual pollination (allogamy): neighbour pollination (geitonogamy) and cross pollination (xenogamy) too. Number of seeds in fruits of the two varieties examined in case of free pollination are presented in Table 2. Data of Table 2 show the trend in the number of seeds in fruits pollinated through this method. As we shall see later, with free pollination the number of seeds in fruits is much higher than either with self-pollination or with exclusive cross pollination.

b) *Self-pollination.* Flowers were not emasculated only isolated in bud stage with cellophane. The number of seeds in fruits developed from non-emasculated, isolated flowers is presented in Table 3. Data of Table 3 show

Table 2

Number of seeds in fruits when growing with space isolation
(Free pollination)
1962—1963

Variety	Number of seeds in fruits
S. melongena L. ssp. *occidentale* Haz., var. *bulgaricum* Fil.	1564.07
S. melongena L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.	1271.73

that in case of self-pollination considerably higher number of seeds develop in fruits than when only exclusive cross pollination could happen. This does not mean, of course, that the two varieties examined have an inclination to self-pollination rather than cross pollination, only pollens get onto the stigma with higher probability in self-pollination than they do in exclusive cross pollination.

Table 3

Number of seeds in fruits of non-emasculated, isolated egg-plants (self-pollination)
1962—1963

Variety	Number of seeds in fruits
S. melongena L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.	315.38
S. melongena L. ssp. *occidentale* Haz., var. *bulgaricum* Fil.	195.75

c) *Exclusive cross pollination.* Flowers were emasculated in bud stage but not isolated subsequently, so pollination may have occurred as mediated either by wind (anemophily) or by animals (zoophily). Results obtained in our investigations are included in Table 4. Data of Table 4 show that the egg-plant is not an obligate self-pollinating plant but a facultative cross pollinating one, as in 1963 a rather high number or seeds were found in fruits depending on varieties. The question whether the egg-plant is an anemophilous or a zoophilous plant cannot be answered by the present investigation. Namely, pollination either by wind or by animals is inhibited by cold, rainy weather (wind and rain beat the floating pollens down; animals do not move about in windy, rainy and cold weather). The anatomy of flowers suggests, however, that the egg-plant is an entomophilous plant. The above phenomena are probably the reasons why in 1962 emasculated and non-isolated plants did not become fertile.

Table 4

Number of seeds in fruits of emasculated, non-isolated egg-plants (exclusive cross pollination)
1962—1963

Variety	Year	Fruit set percentage	Number of seeds in fruits
S. melongena L. ssp. *subspontaneum* Fil. var. *leucoum* Alef.	1962 1963	— 80.00	— 31.87
S. melongena L. ssp. *occidentale* Haz. var. *bulgaricum* Fil.	1962 1963	— 50.00	— 63.60
Selfed *S. melongena* L. ssp. *occidentale* Haz. var. *bulgaricum*	1963	60.00	174.50
S. melongena L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil.	1963	50.00	493.20

3. *Artificial pollination.* The term "artificial pollination" means the method of pollination in which pollens are carried to the stigma by deliberate human intervention, i.e. with outer help.

a) *Intravarietal crossing.* Pollination of emasculated flowers was performed by using the pollens of another plant of the same variety. Results obtained with this method of pollination are presented in Table 5. Its data show that the number of seeds in fruits is considerably higher than with self-pollination and considerably lower than in case of free pollination. Free pollination produces more seeds in the fruits of *S. melongena* L. ssp. *occidentale* Haz., var.

Table 5

Number of seeds in fruits of intravarietal egg-plant crosses
1963—1965

Combinations	Fruit set percentage	Number of seeds in fruits
S. melongena L. ssp. *subspontaneum* Fil. var. *leucoum* Alef. *S. melongena* L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.	×80.00	641.95
S. melongena L. ssp. *occidentale* Haz., var. *bulgaricum* Fil. *S. melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil.	×35.00	679.01

bulgaricum Fil. than in the fruits of *S. melongena* L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.; with self-pollination it is the other way round; in intravarietal crosses there is no significant difference between the two varieties in the number of seeds in fruits.

b) *Intervarietal crossing.* Pollination of emasculated flowers was performed with the pollens of another variety. There were direct and reciprocal crosses. Results obtained in intervarietal crosses are presented in Table 6. Data of Table 6 show that in fruits of intervarietal crosses the number of seeds is lower than in those originating from intravarietal crossing. Furthermore, the data show that fertility is influenced also by the combining ability; namely the same variety gives different results in different combinations. The effect of either the pollen plant or the seed plant could not be demonstrated in our investigations.

Table 6

Number of seeds in fruits of inter-crossed egg-plant varieties
1963—1965

Variety	Fruit-set percentage	Number of seeds in fruits
S. melongena L. ssp. *occidentale* Haz., var. *bulgaricum* Fil. × *S. melongena* L. ssp. *subspontaneum* Fil., var. *leucoum* Alef.	44.37	555.28
S. melongena L. ssp. *subspontaneum* Fil., var. *leucoum* Alef. × *S. melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil.	82.50	607.40
S. melongena L. ssp. *orientale* Fil., var. *pecinense* Fil. × *S. melongena* L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil.	25.00	449.00
S. melongena L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil. × *S. melongena* L. ssp. *orientale* Fil., var. *pecinense* Fil.	100.00	615.20
S. melongena L. ssp. *occidentale* Haz. var. *Kasgharicum* Fil. × *S. melongena* L. ssp. *subspontaneum* Fil. var. *leucoum* Alef.	33.33	722.00
S. melongena L. ssp. *subspontaneum* Fil. var. *leucoum* Alef. × *S. melongena* L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil.	66.66	634.50
S. melongena L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil. × Selfed *S. melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil.	80.00	1213.12
Selfed *S. melongena* L. ssp. *occidentale* Haz., var. *bulgaricum* Fil. × *S. melongena* L. ssp. *occidentale* Haz., var. *Kasgharicum* Fil.	90.00	1479.11

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STUDIES ON THE CHANGES IN PEROXIDASE ACTIVITY IN PAPAVER SOMNIFERUM L. VARIETIES DURING ONTOGENESIS

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The peroxidase activity and morphine content was studied in the leaf and main axis tissues of 4 poppy varieties at the time of flowering. Peroxidase levels and morphine contents were also determined in the capsules during capsule ripening. Peroxidase activity in the capsule followed a maximum curve during capsule development. Maximal values were reached approximately 2 weeks after flowering. The morphine content also followed a maximum curve except for the variety "Soproni" the morphine level of which remained approximately constant after reaching a plateau. The possible correlation between peroxidase activity, climatic conditions and morphine content are discussed.

Introduction

The upper parts of the poppy plant or the capsules in the stage of opium ripeness are regarded as the best sources for obtaining the highest morphine yield [Malin (1907), Fuchs (1932), Moser (1948), Römisch (1958), Nilov—Nilova—Troshchenko (1936)]. Still, because of technological difficulties, on a large scale basis alkaloids are extracted even today from dry capsules. Thus, the problem whether the morphine content of the capsule decreases or increases during ripening is of a paramount practical importance. Küssner (1940), Wegner (1951) observed an increase in morphine even in the latest stages of ripening. By contrast, Moser (1948) reported on a 50 per cent decrease in morphine content in the capsules during ripening and attributed this effect to the activity of peroxidase enzymes. Similarly, Nilov—Nilova—Troshchenko (1936) explained the decrease in morphine by enzyme action. They termed the enzyme (complex) involved "opiase" which was inhibited by NaF. Römisch (1958) on the basis of detailed studies on two poppy varieties, also came to the conclusion, that 2 weeks after flowering a constant decrease in morphine content sets in. Studies of Sárkány—Dános (1957) on their poppy variety "SB-morfin" and those of Michels-Nyomárkay (1964) also pointed in this direction.

In view of the contradictory results and opinions outlined above I have started studies on the peroxidase activity in various organs of the poppy variety "SB-morfin" during development, together with a quantitative determination of the morphine content of the capsule. The results obtained supported the concept of decreased morphine content in the more advanced developmental stages (Farkas-Riedel 1967). To provide additional evidence, it appeared desirable to carry out a parallel investigation of peroxidase activity and morphine content during development in poppy varieties differing in the pattern of ontogenetic development and morphine yield.

Materials and Methods

The following 4 varieties were included in the investigation: *Papaver somniferum* L. variety from India (Fig. 1), with low morphine yield, short vegetative period, relatively small plant size, unbranched stem, small capsules, relatively few and small leaves. *P. somniferum* L. var. "Turkish" with high yield, (Fig. 2) medium vegetative period, from medium to relatively large plant size, few branches, medium leaf and capsule size. *P. somniferum* L. var. "SB-morfin" (Fig. 3) with high morphine yield, medium vegetative period, heavy branching, intensive vegetative development, large leaves and capsules. *P. somniferum* L. var. "Soproni" (Fig. 4) with extremely high morphine yield (with no indication of a decrease in morphine content during ripening), relatively long vegetative period, tall vegetative growth, medium-sized leaves and capsules.

The 4 varieties were analyzed during 2 vegetative periods at different times of ontogenetic development for peroxidase activity and morphine content. The analyses were carried out in triplicates.

Peroxidase activity was assayed spectrophotometrically as described by Farkas—Stahmann (1966). The morphine content was determined according to Pfeifer (1956).

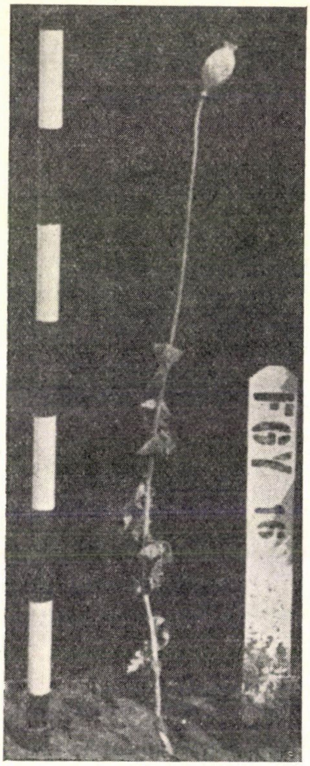

Fig. 1. Papaver somniferum L. variety from India

Fig. 2. Papaver somniferum L. variety "Turkish"

Fig. 3. Papaver somniferum L. cv. "SB-morfin"

Fig. 4. Papaver somniferum L. cv. "Soproni"

Results

Peroxidase activity of the leaf tissues. Results are summarized in Fig. 5. With the poppy varieties "SB-morfin", the variety from India and "Turkish" essentially the same type of dependence of peroxidase activity on leaf insertion level was found. There is a peak of peroxidase activity at low insertion levels (insertions 9—12 from below) followed by a marked minimum (insertions 13—16) and by a second maximum in well developed leaves (insertions 17—29 depending on the variety). This trend with two peaks of peroxidase activity, if it is expressed as a function of leaf insertion level, corresponds very well to the earlier observations (FARKAS-RIEDEL 1967). A somewhat different picture was obtained with the variety "Soproni". In this case, too, a maximum of peroxidase activity, characteristic for the lower leaves was observed, however, the second peak in the area of well developed higher leaves was much less pronounced. In addition, the peroxidase activity started to decline above the insertion level 17—20.

Peroxidase activity of the main axis. Peroxidase activity was determined at the time of flowering. Results are summarized in Table 1. It may be seen, that the peroxidase level of the 4 studied varieties differed considerably: "Soproni" < variety from India < "Turkish" < "SB-morfin".

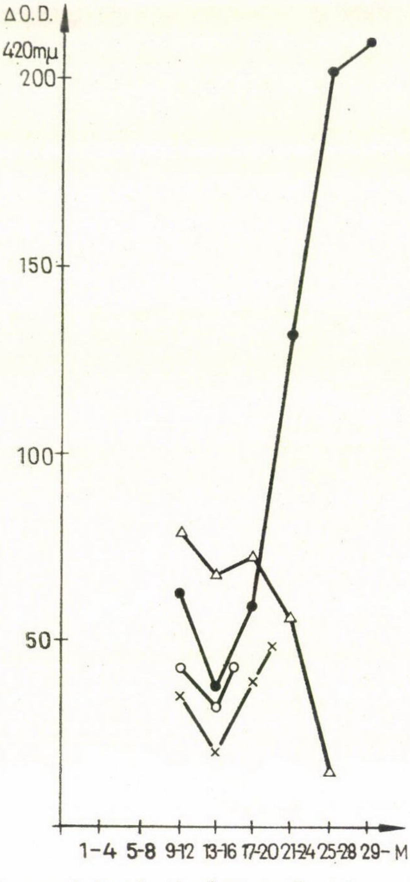

Fig. 5. Changes in peroxidase activity in the leaves of various poppy varieties at different insertion levels at the time of flowering

Peroxidase activity of the capsules. Results are summarized in Fig. 6. With all the four varieties studied peroxidase activity exhibited a maximum curve during the development of the capsule. It should be noted that the maximum is reached essentially at the same time in the "Soproni", "SB-morfin" and "Turkish" varieties (about 2 weeks after flowering). With the variety from India the peak of peroxidase activity occurs earlier and the peak is followed by a very rapid decrease in peroxidase activity, at a time when peroxidase still increases in the capsules of the other varieties. This is most probably due to

the more rapid drying of the capsule as compared to other varieties. As far as the absolute values of peroxidase activity are concerned, these differ markedly, the lowest values were obtained with the variety "Soproni" and the highest with the varieties "Turkish" and "SB-morfin", if the comparison is being made at the time when the peak is reached. Peroxidase activity falls to zero during the ripening of the capsule with all varieties but the time when this occurs depends on the speed of the loss of water content. The latter is the highest in the case of the variety from India the capsule of which is very thin-walled and has relatively loose tissue texture. An opposite, extreme type is

Table 1

Peroxidase activity at the time of flowering

Organ	Peroxidase activity △ O. D. 420 mμ/1 g fresh weight				Morphine content $^0/_{00}$ in dry matter			
	T	I	SB	S	T	I	SB	S
Leaves of 9—12 insertion	35.0	42.5	62.5	79.0	—	—	—	—
Leaves of 13—16 insertion	20.0	32.5	37.5	67.5	—	—	—	—
Leaves of 17—18 insertion	—	43.0	—	—	—	—	—	—
Leaves of 17—20 insertion	39.0	—	59.0	72.5	—	—	—	—
Leaves of 21—22 insertion	48.0	—	—	—	—	—	—	—
Leaves of 21—24 insertion	—	—	132.5	56.0	—	—	—	—
Leaves of 25—28 insertion	—	—	202.0	15.0	—	—	—	—
Leaves of 29— insertion	—	—	210.0	—	—	—	—	—
Main axis	56.0	50.0	153.0	12.5	—	—	—	—
Capsule (ovary) at the time of flowering	56.0	55.0	75.0	3.0	2.9	2.05	3.6	3.4
Capsule-wall 1 w. a. fl.	85.0	70.0	141.5	7.5	5.1	3.7	6.8	7.3
Capsule-wall 1½ w. a. fl.	—	80.0	—	—	—	3.25	—	—
Capsule-wall 2 weeks a. fl.	172.5	20.0	178.5	28.0	7.7	3.0	8.3	8.0
Capsule-wall 2½ weeks a. fl.	—	3.5	—	—	—	2.8	—	—
Capsule-wall 3 weeks a. fl.	87.0	—	100.0	12.0	7.2	2.8	7.6	8.5
Capsule-wall 3½ weeks a. fl.	10.0	—	22.0	—	6.9	—	6.7	—
Capsule-wall 4 weeks a. fl.	—	—	—	2.0	6.8	—	6.4	8.6
Capsule-wall 5 weeks a. fl.	—	—	—	—	6.0	—	6.4	8.8

T *Papaver somniferum* variety "Turkish"
I ,, ,, ,, from India
SB ,, ,, cv. "SB-morfin"
S ,, ,, cv. "Soproni"
w.a.fl. Week after flowering
a.fl. After flowering

represented by the capsules of the variety "Soproni". In this case the capsule has a very compact tissue structure with remarkably thick wax-coating which retards water loss.

Morphine contents. Morphine contents are summarized in Table 1. It can be seen that with all varieties there is an increase in morphine content in the capsule reaching a peak at different times in different varieties. The peak is followed during ripening by a decrease in morphine content in all varieties except in the variety "Soproni" where it proved to be fairly constant if not somewhat increasing.

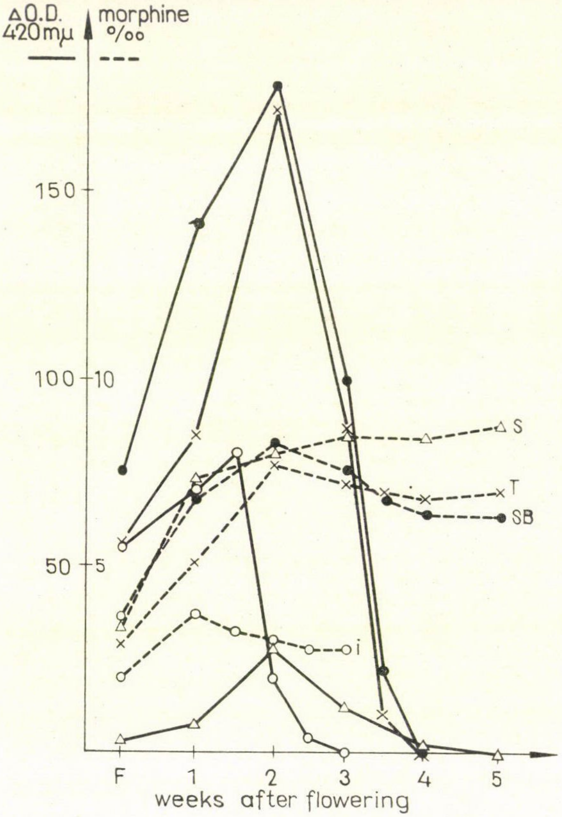

Fig. 6. Changes in peroxidase activity and morphine content in the capsule of various poppy varieties

Discussion

If we compare the results obtained with those published earlier (Farkas-Riedel 1967) we might come to the conclusion that the trends both in changes in peroxidase activity and morphine content in the capsule wall are similar. The small differences observed with the variety "SB-morfin" are apparenty due to the drier conditions prevailing in 1967 and 1968 as compared to 1966. The drier conditions result in a more rapid decline in peroxidase activity. A small decrease in morphine content was found under dry conditions (1967, 1968) as compared to the more pronounced decrease for 1966. This suggests an inverse correlation between peroxidase activity and morphine content. The same tentative conclusion might be drawn from the data presented in Fig. 6. The decrease in morphine content during ripening of the capsule tends to be more pronounced with the two varieties ("SB-morfin" and "Turkish") which are characterized by a somewhat slower decrease in peroxidase level in the drying capsule. The above observations are in line with the report of RASMUSSEN-BAGGESGAARD—LANNG (1948) and by POETHKE—ARNOLD (1951) on the effect of weather condition on morphine content. They also observed, that in dry weather the morphine content is higher in the ripening capsule-wall than under more humid conditions, which might lead even to a washing out of morphine.

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FERTILIZATION OF SUDAN GRASSES

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Domestic and foreign results of the fertilization of Sudan grass as summarized on the basis of Hungarian field experiments and foreign literary data are presented. Examinations performed as well as literary data show that fertilizers — especially nitrogen — have a marked increasing effect on the yield. N fertilizers given instead of farmyard manure are more effective than farmyard manure in itself. Outstanding results are obtained by applying half doses (174 q/ha) of farmyard manure supplemented with an equivalent N fertilizer. In addition to their yield increasing effect, fertilizers — first of all nitrogen — increase the crude protein — and also the HCN content of Sudan grass.

Introduction

Literary data are in a complete accord concerning the yield increasing effect of fertilizers — first of all nitrogen. As for the effects of P and K, opinions differ due mainly to differences in soil conditions.

For example, in USA, Vinall—Getty (1921) consider N and P fertilizers as necessary for high yields. Broyles—Fridourg (1959), Rusoff *et al.* (1961) found that it was not only the yield but also the protein content of Sudan grass that was considerably increased by nitrogen. Ahlgren (1956), Morrison—van Keuren (1962), too, emphasize the importance of nitrogen but consider full fertilization preferable. Jung *et al.* (1964) also obtained significant differences in yield, moreover, amino acid level changed as well. At the same time they pointed out that not only the yield but also the HCN content was increased by N. Summer—Martin (1965) similarly applied nitrogen on sandy loam with good results. In N-treatments an increase of crude protein and NO_3 contents has been found, too. In Australia in Arndt—Phillips' experiments (1961) PN fertilization resulted in a significant yield surplus, too; on the other hand K did not increase the yield. In the Soviet Union Elsukov—Movsisyanc (1951) found that among nutrients especially N had a beneficial effect on the yield but farmyard manure could also be used with success. 18—20 ton/ha organic manure applied to czernozyem type soils had increased the yield by 22.8—37.3 per cent as compared to the untreated control. P, too, was used with success but K was ineffective under those conditions. Solovev (1954) suggests that high yields of Sudan grass require fertilization applied under preceding crops. GIRENKO (1954) is a believer of full fertilization. According to his observations the effect of fertilization can be especially well seen in the second growth. DRAGALIN (1955) considers both the organic and inorganic fertilizers to play an important role in producing high yields. According to PODOLICH *et al.* (1956) peat soils require N, while podzol soils K. In Bulgaria MAMAROVA (1960) used N with success. She obtained in her experiments a surplus yield of 23 per cent compared to the untreated control. On the other hand, PK fertilizers applied in early spring had no effect. According to HUGUES (1932) in France, Sudan grass produces high yields only in fertile soils rich in nutrients. In Italy, according to LANDI (1964) high yields of *Sorghum* require, by all means, the precondition of a good nutrient supply. Best results were obtained with a ratio of N : P = 1 : 1. In Spain in experiments carried out by BESNIER (1964) and ROMERO (1966) not only the yield but also the protein content of Sudan grass was increased by N-fertilization. In Roumania, KELLNER *et al* (1964) found an increase in the yield of Sudan grass as a result of NP-fertilization. In their experiments in south-western Roumania they obtained a yield surplus of 27 per cent by applying N alone and of 36 per cent with NP fertilizers. TIRU (1964) in his comparative study on maize, sorghum and Sudan grass obtained high yields when applied fertilizers in large quantities to after-crops under irrigation. In Germany, in a comparative study on silage maize, sweet sorghum and *Sorghum technicum*, ATANASIU—SHABAN (1964) obtained the best results with the latter. They considered nitrogen to be favourable for the increase of average yields ALKÄMPER (1966) emphasizes the high fertilizer requirement of Sudan grass, the importance of N-fertilization but, at the same time, points out that large volumes of N increase the HCN content of forage. In Hungary, DWORÁK's (1932) studies on the nutrient uptake of Sudan grass suggest that the fertilizer requirement of Sudan grass is higher than that of most crops. SURÁNYI (1956), BAJAI *et al.* (1961) and BARABÁS (1968), too, point out the importance of N-fertilization. BÁRDOSSY (1961) obtained 18 per cent higher yield on the average of 2 years by applying 70 kg/ha N in his experiments, at the same time also the crude protein content increased by 25 per cent. KÜKEDI (1963, 1964) found that the N fertilizer equivalent of the N active agent of farmyard manure was more effective in his experiments. The hybrid Sudan grass (Hybar Mv 301), too, made good use of fertilizers, especially of N (KÜKEDI 1966). With 174 kg/ha applied its green yield increased by 40 per cent compared to the control. However, not only the yield but also the crude protein content was increased by the N-fertilization. In LŐRINCZ's (1967) fertilization and irrigation experiments carried out with Sudan grass sown with sunflower and pea on sand soils, the surplus yield obtained by NPK fertilization ranged from 40.7 q to 42.8 q per ha. After this survey of literary data two experiments conducted at Martonvásár, Hungary is going to be discussed.

Materials and Methods

The experiments were carried out at Martonvásár, at the Agricultural Research Institute of the Hungarian Academy of Sciences in 1959, 1960, 1961 as well as in 1964, 1965 and 1966. The earlier experiments were set in on split-plots while the latter ones in a randomized block design, on the czernozyom soil of a former forest. Considering that crop results were influenced by the weather to a considerable extent, the presentation of some meteorological data is thought to be necessary. As for the weather conditions of the earlier experimental years, author mentions that in 1959 and 1960 they were very favourable, while in 1961 unfavourable. Among the data of 1964, 1965 and 1966 the most important ones: temperature and precipitation are shown in Table 1.

Table 1

Temperatures in 1964, 1965, 1966
(C°)

Year	Months												Annual aver-ages
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	
1964	—7.6	0.3	2.7	11.9	15.7	22.1	21.2	18.8	15.8	10.1	6.9	0.2	9.8
1965	—0.2	—1.5	5.4	9.3	14.4	19.0	20.1	18.7	16.5	9.0	2.3	1.6	9.5
1966	—4.0	6.4	5.9	13.3	17.2	20.4	21.0	20 4	16.8	15.2	4.9	1.8	11.6
Averages of 40 years (1901—1940)	—1.9	—0.3	5.2	10.1	15.9	19.1	21.5	20.7	15.7	10.6	4.6	0.2	10.2
Precipitation monthly and annual													
1964	3	32	39	37	32	145	55	68	24	133	33	73	674
1965	29	7	32	67	73	179	78	88	83	1	136	64	837
1966	40	33	52	49	59	53	159	87	10	72	99	47	760
Averages of 40 years (1901—1940)	31	31	39	46	66	62	50	52	52	53	46	43	571

Results

Table 2 shows the experimental results of sweet Sudan grass treated with farmyard manure and fertilizers. The values of crude protein content depending on fertilizers applied are presented in Table 3.

Three years averages of the N-fertilization experiments carried out the first time in Hungary with sweet Sudan grass are shown in Table 4. Table 5 presents a mathematical evaluation of fertilization experiments of sweet Sudan grass.

When examining the effects of fertilizers we find that 87, 174 and 261 kg/ha N equivalent of 174, 348 and 522 q/ha farmyard manure increased the yield by 22.4, 59.6 and 65.5 per cent respectively as compared to the untreated

Table 2

Dry matter production of the sweet Sudan grass as depending on fertilization, on the average of 3 years (1959, 1960, 1961) at Martonvásár

Treatments (fertilizers)	Farmyard manure q/ha							
	Ø	174	348	522	Ø	174	348	522
	Dry matter production, q/ha				Relative number, q/ha			
Ø	52.5	54.3	65.7	65.5	100.0	103.4	125.1	124.7
P	52.5	59.1	65.1	75.8	100.0	112.5	124.0	144.3
N_1	62.9	72.8	77.9	80.2	119.8	138.6	148.3	152.7
N_1 P	64.3	69.7	76.0	79.6	122.4	132.7	144.7	151.6
N_2	83.8	79.4	87.7	95.9	159.6	151.2	167.0	182.6
N_2 P	81.2	79.4	86.5	97.9	154.6	151.2	164.7	186.4
N_3	86.9	92.2	94.6	97.5	165.5	176.6	180.1	185.7
N_3	92.2	94.3	95.1	102.4	175.6	179.6	181.1	195.0

Abbreviations: P = 104 kg/ha P_2O_5, N_2 = 174 kg/ha N
N_1 = 87 kg/ha N N_3 = 261 kg/ha N

Table 3

Changes in the crude protein content of sweet Sudan grass depending on fertilization, on the average of 3 years (1959, 1960 and 1961)

Treatment	Percentage crude protein related to 100 per cent dry matter				Relative number on average of 3 years	Abbreviations
	1959	1960	1961	3 years' average		
Ø	8.8	7.0	8.2	8.0	100.0	
D_1	8.8	8.0	6.8	8.1	101.2	D_1 = 174 q/ha farmyard manure
D_2	8.2	8.2	6.5	8.3	103.7	D_2 = 348 q/ha farmyard manure
D_3	7.0	7.0	7.4	7.1	88.7	D_3 = 522 q/ha farmyard manure
P	7.0	8.4	6.1	7.2	90.0	P = 104 kg/ha P_2O_5
N_1	10.2	8.8	8.7	9.2	115.0	N_1 = 87 kg/ha N
N_2	14.0	10.7	10.7	11.8	147.5	N_2 = 174 kg/ha N
N_3	12.2	13.7	8.8	11.6	145.0	N_3 = 261 kg/ha N
D_1 N_1	10.1	11.9	6.7	9.6	120.0	
D_1 N_2	11.7	11.9	7.0	10.2	127.5	
D_1 N_3	12.8	13.0	8.4	11.4	142.5	

Note: Data of crude protein concern the main crop.

control, while the above quantities of farmyard manure by 3.4, 25.1 and 24.7 per cent respectively. Differences in yield are highly significant as compared to the untreated control. On the other hand, P applied by itself was ineffective while, supplemented with other fertilizers — especially with large doses of

N — a remarkable interaction, a surplus yield can be obtained. NP fertilizers added to farmyard manure have also a highly favourable effect, therefore it is of great advantage to supplement farmyard manure with fertilizers.

Results of examinations of the crude protein content as related to 100 per cent dry matter content (Table 3) show that not only the yield but also the crude protein content of the forage is increased by N-fertilization. It is remarkable, at the same time, that — apart from a single exception (treatment D_3) — crude protein content of the forage was not significantly influenced by farmyard manure applied. Differently it showed a definite dextrease in the treatment with 522 q/ha farmyard manure as well as in the one with P alone.

Table 4

Dry matter production, crude protein content and fertilizer recovery of Hybar Mv 301 as depending on N-fertilization (averages of 3 years, 1964, 1965, 1966)

Treatment	Dry matter production, q/ha				Relative number				Percentage crude protein on the average on the years		Recovery of fertilizers %
	1964	1965	1966	3 years' average	1964	1965	1966	3 years' average	main crop	second growth	
0	74.3	64.6	70.8	69.9	100.0	100.0	100.0	100.0	9.6	6.7	—
44 kg/ha N	90.7	75.0	84.4	83.3	122.0	116.0	119.2	119.1	9.3	6.7	38.5
88 kg/ha N	94.2	76.5	90.1	86.9	126.7	118.4	127.2	124.3	11.0	6.2	43.9
132 kg/ha N	92.0	82.8	100.7	91.8	123.8	128.1	142.2	131.3	12.2	6.2	41.7
176 kg/ha N	90.5	82.2	116.2	96.3	121.8	127.2	164.1	137.7	14.2	7.7	50.7
220 kg/ha N	86.3	83.3	123.9	97.8	116.1	128.9	175.0	139.9	14.1	7.6	39.5
S.d. to 95%	3.3	3.6	5.2	8.6	4.4	5.6	7.3	12.3			

According to the results of N-fertilization experiments carried out with hybrid Sudan grass (Table 4) the surplus yield compared to the untreated control was 19.1—39.9 per cent on the average of 3 years. Differences in yield are highly significant as compared to the unfertilized control.

Results of crude protein examinations on the average of 3 years confirm again the earlier findings, i.e. that N — in addition to its yield increasing effect — increases the crude protein content of forage, too. Data of the Tables show that the main crop — on 3 years' average — is richer in crude protein than the after growth. This statement is, however, not always valid, because e.g. in 1965 when the weather was unusually cold and lacking sunshine, the main crop was poorer in crude protein.

Calculations made on the utilization of fertilizers show that with 174 kg N applied per ha, 50.7 per cent of the N active agent has been recovered by the yield, therefore under Hungarian conditions this treatment proves to be the best.

Table 5

Variance Table

Fertilization experiment with sweet Sudan grass on the average of 3 years — 1959, 1960 and 1961

Cause of variability	SQ	Szf	MS
Year (E)	12,256.90	2	6,128.45***
Block (B)	1.14	2	0.57
Year×block (E×B) = error *a*	1.84	4	0.46
Farmyard manure (D)	351.28	3	117.09***
Year×farmyard manure (E×D)	128.07	6	21.34
B×D			
= error *b*	172.11	18	9.53
E×B×D			
Nitrogen (N)	1,767.54	3	589.18***
Phosphorus (P)	2.72	1	2.72
Nitrogen×phosphorus (N×P)	13.73	3	4.57***
Fertilizer treatments (M) total	(1,783.99)	(7)	254.85***
Year×fertilizer treatments (E×M)	502.62	14	35.18***
Farmyard manure×fertilizer treatments (D×M)	64.84	21	3.08***
B×M			
E×B×M			
E×D×M = error *c*	103.20	210	0.49
B×D×M			
E×B×D×M			
Total:	15,365.66	287	
Correction on account of the average	68,740.14	1	
$\sum x^2$	84,105.80	288	

* P 5%
** P 1%
*** P 0,1%

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OPTIMUM COMPOSITION OF EMULSIFYING PLANT PROTECTIVES

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The paper discusses the mode of choosing the optimum composition of finished plant protectives, illustrated by way of example on 2.4-dichloro-phenoxy-acetic acid-octyl ester as active agent. Qualification was based on 24 hours emulsion stability of the emulsified agent. When selecting the emulgator we used solutions containing 2 to 4 percent of emulgator. Xylene as solvent and Emulsogen IT as emulgator were found to be the most suitable for the given active agent. The finished product consisting of three components can be considered as a ternary system, the behaviour of which is the function of the ratio of components. Properties depending on the ratio of components can be characterized quantitatively by plotting the composition. As the result of our measurements we plotted a ternary diagram of the (2.4-dichloro-phenoxy-acetic acid-octyl ester)-xylol-Emulsogen IT system. The ternary diagram gave precise information on the compositions, at which our emulsifying product forms stable emulsions with water.

Introduction

A considerable proportion of plant protective active agents is used in form of emulsion. Under normal conditions emulsions are mechanical combinations of inmiscible liquids, i.e. the fine dispersion of a liquid in another inmiscible liquid. Every emulsion consists of an external phase, and an internal phase, distributed into minute drops of 0.1 micron in diameter (BECHER 1965, SUTHEIM 1946). With emulsifying plant protectives the active agent is contained in the disperse phase and water is the dispersion medium.

The processing of active substances into emulsified plant protectives is a complex task. The most suitable solvents and emulgators have to be selected for a given active agent. Apart from physical, chemical and biological factors, economic factors too must be taken into consideration. Our present paper gives detailed information on the method by which active agents are processed into emulsified plant protectives. The method for choosing the proper composition is demonstrated on the example of 2.4-dichloro-phenoxy-acetic acid-octyl ester.

Material and Method

1. *Active agent.* 2.4-dichloro-phenoxy-acetic acid-octyl ester (2.4-D-octyl ester). As no pure active agents were available, we prepared the ester from a commercial product: Dikonirt, the sodium salt of 2.4-dichloro-phenoxy-acetic acid. 2.4-dichloro-phenoxy-acetic acid was lib-

erated from the sodium salt with hydrochloric acid. The product obtained is a white, crystalline compound. With the acid thus produced n-octyl alcohol was esterified in the presence of p-toluol-sulphonic-acid, as catalyst in xylene medium. The product formed was a brown oily liquid of 1.172 g/ml specific weight. Its chlorine content was 21.0 per cent, as compared with the theoretical 21.6 per cent. The product was not of analytical purity, but this was not necessary from the point of view of our work.

2. *Qualification.* The most important property of emulsions: emulsion stability was chosen as the basis of qualification. Emulsion stability can be determined by the change with time of the emulsions prepared with water of given quantity and hardness. From the finished active agent a 1.5 per cent emulsion has been prepared with tap water of 23 German degree of hardness, adding the first 10 ml of the necessary amount of water drop by drop to 1.5 ml of the finished product, and shaking the sample after every drop, before adding the rest of the water.

With a stable emulsion no change can be observed even after 24 hours. The emulsion is considered as good when on standing it does not change for 2 hours, and changes occurring after this time are reversible. Our investigations were based on a 24 hour emulsion stability of emulsified plant protectives (KAERTKEMEYER—AMAND 1966, JOSEPOVITS 1951).

Most active agents used as plant protectives are insoluble or very sparingly soluble in water; they are used in low concentrations, and therefore, require solvents. The stock-solution of the agent in a solvent is placed on the market. The most frequently used solvents are: benzene, toluene, xylene, solvent naphtha and various petroleum products. They have different hydrophobic properties, which have to be taken into consideration when a solvent is chosen. When the solvent is of highly hydrophobic character, with the same total amount of emulgator the quantity of the hydrophobic component must be increased, e.g. in the case of aromatic compounds and heavy aliphatic solvents.

In the processing of a given active agent the solvent must possess all those good properties which ensure storability. Products with a freezing point below —20° C and an ignition point near 20° C can be well stored.

Specific weights, freezing- and ignition points of a few suitable solvents are shown in Table 1.

Table 1

Physical constants of some solvents used in plant protectives (MÁZOR 1966)

Solvent	Specific weight g/ml	Freezing point °C	Ignition point °C
Benzene	0.8790	5.5	—11
Solvent naphtha I.	0.8740	—96.0	21
Toluene	0.8669	—95.0	4
Xylene	0.8802	—29.0	20

Among the four solvents presented in the table solvent naphtha and xylene ensure good storability.

With solvents the economic factors should particularly be taken into consideration, since a considerable proportion of the agent to be emulsified consists of solvents. The world market price of the solvent naphtha is 80—100 $/t, that of the xylene 60 $/t. After taking both physical properties and world market prices into consideration, we chose technical xylene as solvent, which contained 19—42 per cent of meta-, 30 per cent of para isomer, and 9 per cent of etil benzene.

In emulsifying sprays, emulsification is promoted by adding surface active substances: emulgators. They are mostly linear compounds of asymmetrical structure, consisting of a hydrophobic part of various chain-length and of a hydrophilic group. The hydrophilic and hydrophobic part of the emulgators ought to be in equilibrium, as only then will stable emulsions be obtained. The ratio of the hydrophilic and hydrophobic forces in the emulgator molecule is decisive for the type of emulsion produced. Emulgators of mostly hydrophobic character give W/S-type emulsions — in which the internal phase consists of water — while highly hydrophilic emulgators S/W-type emulsions. In these latter emulsions the internal phase consists of oil or some other liquid which is inmiscible with water (WINNACKER—KÜCHLER 1963).

In order to ensure hydrophilic-hydrophobic equilibrium expediently emulgator mixtures consisting usually of a non-ionic and an anion-active component will be used. Such mixtures ensure emulsion stability by the fact that one of their components is more soluble in water, while the other in oil (GRIFFIN 1954). Some of the commercial products consists of such mixtures (Table 2).

Table 2

Emulgators tried in working up 2.4-D-octyl ester

Manufacturer	Emulgator	Type of emulgator	Stability of emulgator
Egyesült Vegyiművek Budapest	Ipamin SG	non-ionic	bad
	Sulfobraz L	anion-active	bad
	Sulf. pataolaj F	anion-active	bad
Hoechst A. G.	Emulsogen IT	anion-active	perfect
	Emulsogen I 24	non-ionic	perfect
	Emulsogen IP	non-ionic+anion-active	perfect
	Phenylsulfonat Ca- Emulsogen EL	anion-active non-ionic	bad
	Emulsogen IC- Emulsogen IT	non-ionic anion-active	bad
	Emulsogen I 24 Emulsogen I 50	non-ionic anion-active	bad
Union Chimique Belge (UCB)	Emullat P 140 HFP	non-ionic anion-active	bad
	Emullat WK	non-ionic + anion-active	perfect
	Emulat EP- Emulat PN	non-onic + anion-active non-ionic	bad
Tensia (Liège)	Tensiofix AS- Tensiofix BS	non-ionic anion-active	bad

With commercial emulgators the manufacturers give a list of the type of active agents, which can be emulsified. Starting from these data, the following of the available emulgators were tried in concentrations of 2—4 percent with 2-4-D-octyl ester solution in xylene (BÁRÁN—SZÉPLAKY 1961).

Out of the emulgators giving perfect emulsions, we used the product Emulsogen IT in working out our example mentioned above.

After the proper solvent and emulgator have been chosen, compositions giving stable emulsions can be determined by means of ternary diagrams.

As the emulsified plant protectives consists of active agents, emulgators and solvents they can be considered as ternary systems whose behaviour is the function of the ratio of components (KAERTKEMEYER—AMAND 1966, VELNICERIU—SIMULESCU—CIOCAN 1964). When selecting a composition, the ratio of two components can be chosen arbitrarily, while the quantity of the third is determined by the other two. Properties depending on the ratio of the components can be characterized quantitatively by the plotting of the composition.

Results

The concentrations characteristic of a ternary system are represented by a ternary diagram (Fig. 1). Points corresponding to the pure components are given by the vertices of the triangle.

When studying the emulsifying plant protectives we may plot the ternary diagram in two ways. Either we start from solutions of the active agent in the given solvent and add to it various amounts of emulgator, or we change the quantity of the solvent in dependence on the quantity of the emulgator used, while keeping the quantity of the active agent constant.

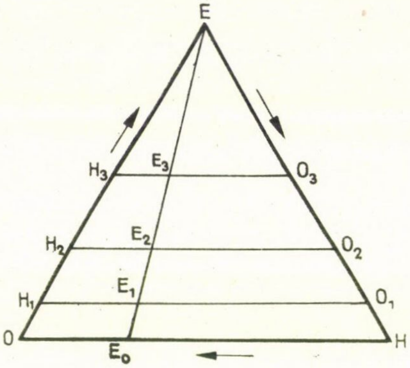

Fig. 1. Concentration characteristic of a ternary system. E: pure emulgator, H: active agent, O: solvent

In the first case, products made from the stock solution can be characterized by the constant ratio of active agent and solvent.

$$\frac{H}{O} = K$$

Compositions characterized by the constant ratio of active agent and solvent can be found on the straight line connecting vertex E of the triangle with one of the points of the H/O side. This straight line is the geometrical place of all the compositions in which H/O = constant. If point E_0 means the initial solution of the active agent in which H/O = constant, co-ordinates of point E_0 can be calculated from the following relationship.

$$\mathrm{O} + \mathrm{H} = 100$$

$$\frac{\mathrm{H}}{\mathrm{O}} = \mathrm{K}$$

$$\mathrm{O} = \frac{100}{\mathrm{K}+1} \quad \mathrm{H} = \mathrm{K} \cdot \mathrm{O} = \mathrm{K} \cdot \frac{100}{\mathrm{K}+1}$$

H and O is the corresponding percentage of the active agent and solvent respectively, in the initial solution before the addition of the emulgator. The ratio K is constant, independently of the mode of expression of the quantity of active agent and solvent. With K known the co-ordinates of point E_0 can be precisely determined and with their aid the actual composition of concentrations characterized by H/O = constant, can be plotted.

Emulsion stability test can be performed by starting fan-like from point E along the different $E-E_0$, $E-E_{01}$, $E-E_{02}$ straight lines.

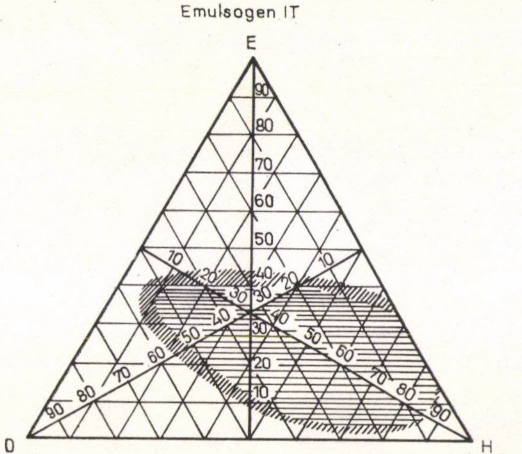

Fig. 2. Emulsion stability diagram of the system (2.4-dichloro-phenoxy-acetic acid-octyl ester)-xylene-Emulsogen IT

According to the other method, we begin the stability test of emulsifying systems from the binary sides and proceed towards the interior of the ternary diagram in dependence on the results obtained.

As a result of these measurements, that area is obtained for the given active agent-solvent-emulgator system within which the agent gives a stable emulsion with water under the prevailing conditions.

Fig. 2 shows the stability diagram of the (2,4-dichloro-phenoxy-acetic acid-octyl ester)-xylene-Emulsogen IT system. The central part marked with lines indicates compositions where the emulsion of the system examined is stable for over 24 hours. This part is surrounded by a thinner layer where emulsion stability is still good, i.e. of 2 hours. In case of any other compositions the product forms an unstable emulsion with water.

This simple method of testing of the emulsion stability of emulsifying plant protectives makes it possible to choose with simple means the best compositions required, and to compare unambiguously the effect of various solvents used with the same active agents and emulgators, or of various emulgators used with the same solvents and active agents.

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RECLAMATION METHODS DEVELOPED FOR SOLONETZ AND SOLOD SOILS WITH A VIEW TO THEIR FORMATION PROCESSES

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Solonetz and solod soils are of low fertility, they need improvement and reclamation. The applied reclamation methods differ depending on the soil properties and on the environmental conditions. Based on genetics and on the properties of these soils a practical grouping was elaborated subdividing the solonetz and solod soils into 3 groups according to their amelioration.

Introduction

Solonetz and solod soils are wide-spread on each continent. They frequently occupy considerable areas but may also occur in spots on fertile lands.

In solonetz soils — as it is generally agreed — the high exchangeable sodium content is responsible for the disadvantageous physical and water properties and for the compact B-horizon. In the A_1 and A_2-horizons of solod soils a very pale layer is formed often with lower salt and exchangeable sodium contents but its physical and water properties are also poor. These properties, hindering water movements and diminishing the water reserve available for plants, cause the low fertility of solonetz and solod soils (ANTIPOV—KARATAEV 1953, 'SIGMOND 1927).

Solonetz soils practically always contain more or less water soluble salts, mainly sodium salts, too (KOVDA 1946—1947). This salt content is not only another factor decreasing soil fertility by increasing the osmotic pressure of the soil solution and, sometimes, by exerting direct toxic effect but by affecting the adsorption complex it also exercises a continuous influence on the composition of the exchangeable cations of the soil (SZABOLCS 1961).

It may be assumed that the low fertility of solonetz and solod soils caused by several factors poses a complex problem in which the salt content and the salt balance of soils play a decisive role (SZABOLCS 1964). This is why when dealing with the problems of both the genetics and the utilization of solonetz soils, one has to examine not only the exchangeable cation content of soils but their water soluble salt content, too (Internat. FAO/UNESCO Sourcebook 1967).

Material and Method

It is well-known that the maximum of the exchangeable Na^+ content of solonetz soils may be found in the B_1 and B_2-horizons. As compared to the B-horizon, as a rule, the A-horizon is poor in exchangeable Na^+. If its A-horizon is thick, the solonetz soil may be relatively more fertile, because it can retain more water available for plants. Based on the above facts, the classification of solonetz soils for both genetical and agronomical purposes has been elaborated as follows:

Name	Thickness of the A-horizon
Shallow solonetz soil	0— 6 cm
Middle solonetz soil	7—16 cm
Deep solonetz soil	thicker than 17 cm

(These limit values may change depending on the local conditions.)

The depth of the water table and the chemical composition of the ground water play decisive roles in the development of the solonetz soil properties. Three schematic cases may be mentioned:

1. The profile is permanently linked with ground water.
2. The profile is temporarily linked with ground water.
3. The profile is not linked with ground water.

In the literature the first group of soils is often named meadow solonetz soil, the second group — meadow solonetz turning into steppe formation and the third one — steppe solonetz.

When dealing with the improvement and the utilization of solonetz soils, the effect of ground water on the soil profile must be taken into consideration because under solonetz soils ground water always contains water soluble salts, including sodium salts.

The solod soils and the solod forming process itself are closely related to solonetz soils and solonetz forming processes. The relation is often so close that it is very difficult to distinguish a solonetz soil from a solod soil, that is why in the literature the solodized solonetz is more frequently mentioned than the pure solod type. Furthermore, although in the literature the solod is described as a leached-out soil, poor in both water soluble salts and exchangeable sodium ions, in practice we often find different properties in this soil type. Especially if the profile is subjected to the permanent or temporary influence of ground water, considerable amounts of water soluble sodium salts and/or exchangeable Na^+ ions may be found in it although it displays the morphological characteristics of a solod. So when reclaiming solod soils we may encounter the same main problems as in the case of solonetz soils.

Discussion

In the literature quite different results may be found concerning the utilization and the reclamation of solonetz soils. These differences are caused partly by the widely varying local conditions (climate, parent material, level of agricultural technology, etc.). The different salt prolifes and salt dynamics — with particular regard to the depth and the quality of the ground water — exercise a decisive influence not only on the genetics of solonetz and solod soils but also on the possible methods of their amelioration and utilization. On this basis, these soils may be subdivided into three main groups:

1. In the case of solonetz and solod soils where the soil profile and the top layers are capillarily linked with salty ground water and the horizons (A_1, A_2, B_1, B_2) contain about 0.2 per cent water soluble salts or more in the surface layer and 0.5 per cent at a depth of 40—50 cm, the leaching out of salts and drainage are unavoidable. In this case the reclamation of solonetz and solod soils may be similar to that of solonchak (salty) soils. As regards

leaching, it may be carried out either by applying irrigation water of good quality and by providing good drainage or — under more humid climatic conditions, when annual precipitation is enough to leach out the salts — by lowering the water table below the critical level. Chemical amendments should also often be applied in parallel with the above mentioned measures or afterwards, especially in the case of heavy textured soils, in order to replace the adsorbed Na^+ in the colloidal fraction by calcium. Sometimes solonchak-solonetz soils may also be reclaimed this way.

As regards the genetics of solonetz and solod soils, mainly the meadow solonetz and meadow solod soils belong to this group. Some genetical and other properties of these soils are presented in Table 1. In Fig. 1 schematic soil profiles, in Fig. 2 schematic salt profiles are shown.

Table 1

Schematic grouping of solonetz and solod soils with regard to their amelioration

Genetic type	Relation with ground water	Water soluble salt content in the surface layers	Amelioration*
1			
solonchak-solonetz meadow solonetz meadow solod (shallow and middle)	permanently linked	more than 0.2 per cent (about 4 mmhos)	drainage and chemical amendments
2			
meadow solonetz and solod soils turning into steppe formation	temporarily linked	about 0.2 per cent (about 4 mmhos)	chemical amendments, deep ploughing and drainage if necessary
3			
deep solonetz and solod soils solonetz-like meadow soils	not linked	less than 0.2 per cent (about 4 mmhos)	low amount of chemical amendments, proper agrotechnics and suitable crop. (deep ploughing, alfalfa, etc.)

* the necessity of irrigation depends on local conditions

2. If the profile of a solonetz or a solod soil is only temporarily linked with ground water, and the salt content of the A, A_1 and B-horizons is lower than in the case of soils belonging to the first group, drainage is not always necessary. Informative data and profiles are presented in Table 1 and in Figs 1 and 2. In these cases the application of chemical amendments (gypsum and/or others) as well as deep-ploughing and subsoil loosening may be useful. If in the B_2 and C-horizons the quantity of water soluble sodium salts is not high and a considerable amount of gypsum is present, in the course of deep-

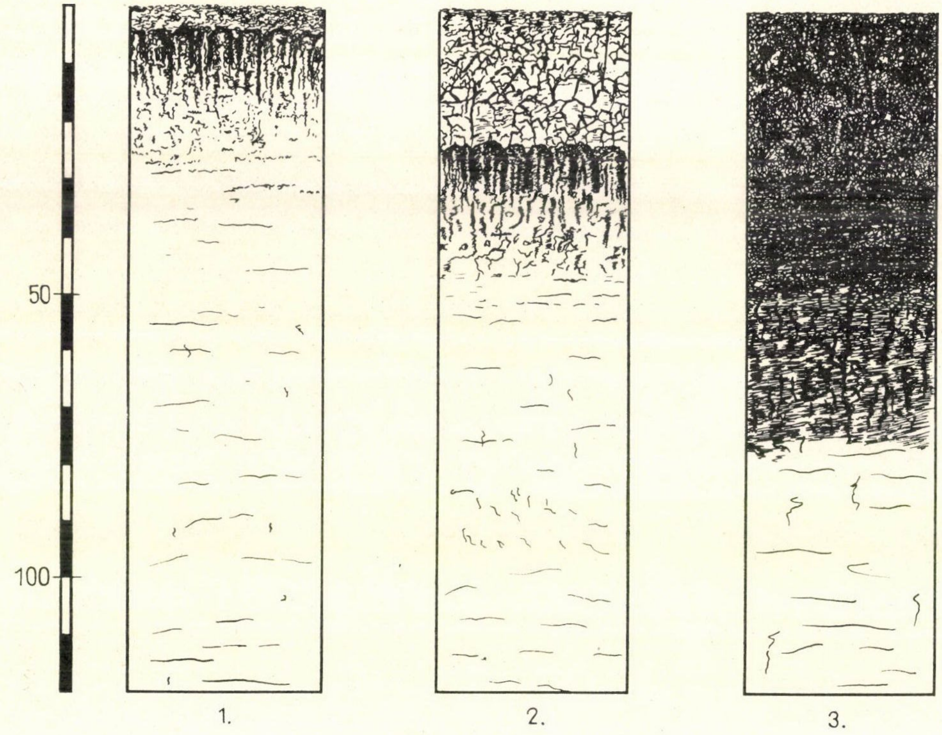

Fig. 1. Schematic solonetz profiles

ploughing it can be utilized as reclamation material. Depending on the local conditions, the amelioration may be carried out either with or without irrigation. Under irrigated conditions, however, the providing of good drainage

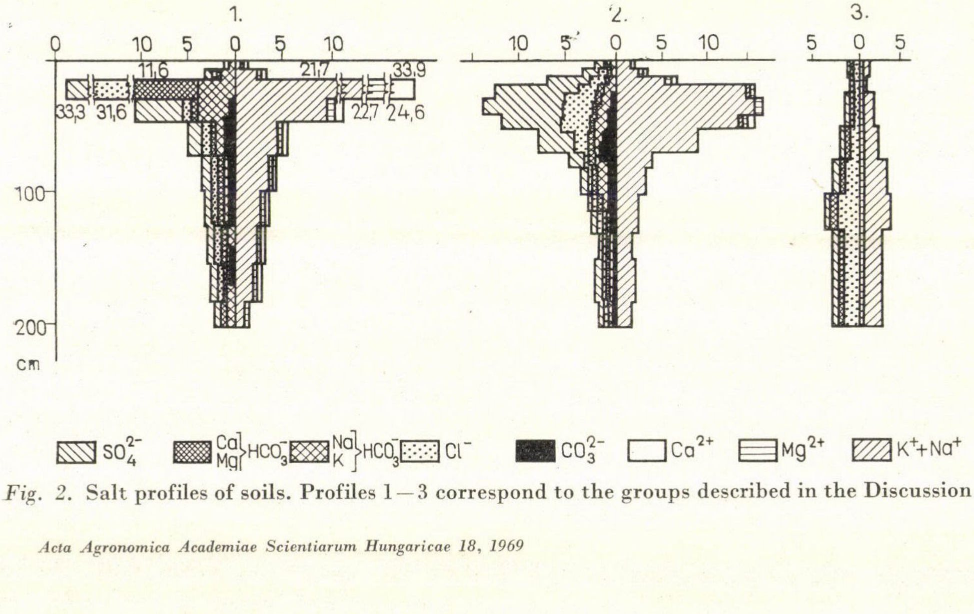

Fig. 2. Salt profiles of soils. Profiles 1—3 correspond to the groups described in the Discussion

is more important. Soils belonging mainly to this group are often called meadow solonetz and solod soils turning into steppe formation.

3. If the profile is not linked with ground water, the salt content in the upper layers of the profile should mainly be taken into consideration when the suitable amelioration method is selected. In these cases when the present, natural soil formation processes assure to a higher or lesser degree the leaching out of water soluble salts, drainage must be satisfactory. Frequently these soils are only moderately solonized and/or solodized. Their exchangeable Na^+ content is less than 10—15 per cent of the cation exchange capacity, and it may be found in a comparatively deeper layer, at more than 15—20 cm below the surface.

In the case of these soils, it is possible to employ non-expensive and simple reclamation methods with good results because the basic aim of reclamation is to facilitate natural leaching out processes. The climatic conditions, the possibility of irrigation, etc. are also decisive factors when the proper methods are chosen to remove the salts and to improve the physical soil properties. Chemical amendments, deep-ploughing and subsoil loosening may be used as indicated in paragraph 2, but the use of proper agrotechnics and the selection of the most suitable plants are very important. Soils belonging to this group are called mainly steppe solonetz and solod soils, and solonetz-like meadow and other soils.

In the following I should like to demonstrate an example of solonetz amelioration described in paragraph 3.

In the Hungarian Plain where various salt affected soils occur including all that belong to the above described three groups, experiments were conducted with alfalfa cultivation on a deep solonetz soil. Alfalfa was grown from 1956 to 1963 and it was regularly irrigated from the second year. The salt content of the profile was determined at the beginning and at the end of the experiment. As can be seen in Table 2, both the dry and the ignition residues of the aqueous extracts of the soil samples considerably diminished in the upper layers of the soil profile due to alfalfa growing. In the deeper layers, however, the accumulation of certain ions could be observed. The decrease in the amount of cations Na and Mg was remarkable just as that of the anions of bicarbonates bound to Na cations. The water soluble humus content of the upper layers, which is one of the features of solonetz process, was also considerably diminished as a result of alfalfa production.

Significant changes occurred in the exchangeable cation contents of soils (Table 3). In the upper horizons the amount of exchangeable sodium was reduced to a quota of the initial condition and a similar trend appeared in the relation of exchangeable magnesium ions. On the other hand, the amount of exchangeable calcium multiplied in the upper layers during the experiment. This may partly be explained by the beneficial effect of alfalfa on the dynamics

Table 2

Analysis of the aqueous extracts of a solonetz soil before and after growing alfalfa on it under irrigated conditions

Depth cm	Dry residue	Ignition residue	Humus	Alkalinity				Cl$^-$	SO$_4^{2-}$	Ca^{2+}	Mg^{2+}	Na$^+$ + K$^+$
				Na$_2$CO$_3$	HCO$_3^-$ (Na, K)	HCO$_3^-$ (Ca,Mg)	HCO$_3^-$					
	%			Na$_2$CO$_3$				me./l				
1956 (before amelioration)												
0— 20	0.133	0.064	0.016	0	1.196	0.105	1.302	0.120	0.354	0.729	0.088	0.817
20— 40	0.148	0.079	0.018	0	1.391	0.088	1.479	0.120	0.250	0.284	0.129	0.413
40— 60	0.229	0.139	0.016	0	1.637	0.153	1.796	0.190	0.371	0.513	0.026	0.539
60— 80	0.176	0.068	0.021	0	1.567	0.211	1.778	0.180	0.250	0.256	0.142	0.398
80—100	0.236	0.090	—	0	1.549	0.130	1.680	0.160	0.208	0.437	0.017	0.448
100—120	0.187	0.104	—	0	1.391	0.034	1.426	0.120	0.437	0.329	0.088	0.417
120—140	0.165	0.063	—	0	1.567	0.017	1.585	0.140	0.300	0.336	0.169	0.505
1964 (after amelioration)												
0— 20	0.056	0.026	0.002	0	0.441	0.338	0.779	0.127	0.052	0.585	0.016	0.379
20— 40	0.048	0.018	0.002	0	0.441	0.252	0.693	0.132	0.162	0.330	0.197	0.544
40— 60	0.078	0.049	0.002	0	0.398	0.400	0.798	0.093	0.829	0.180	0.090	0.470
60— 80	0.184	0.171	0	0	0.926	0.020	0.946	0.144	3.775	0.405	0.362	4.378
80—100	0.168	0.136	0	0	0.926	0.398	1.324	0.096	2.979	0.385	0.148	4.047
100—120	0.119	0.114	0	0	1.009	0.295	1.305	0.124	1.652	0.195	0.131	2.953
120—140	0.098	0.071	0	0	0.967	0.211	1.179	0.124	0.702	0.150	0.007	2.815

Table 3

Exchangeable cations of a solonetz soil before and after growing alfalfa on it under irrigated conditions

Date of sampling	Depth cm	Na$^+$ + K$^+$	Ca^{2+}	Mg^{2+}	CEC	Na$^+$ + K$^+$	Ca^{2+}	Mg^{2+}
		me/100 g				in % of CEC		
1956	0—20	7.6	12.3	8.1	28.0	27.1	43.5	28.9
	20—40	12.5	15.7	23.4	51.6	24.2	30.4	45.3
	40—60	14.7	5.4	18.3	38.4	38.2	14.0	47.6
1964	0—20	0.39 0.59	26.20	5.76	32.94	3.06	82.03	18.02
	20—40	0.83 0.49	23.95	5.78	31.05	4.23	77.21	18.56
	40—60	4.35 0.50	23.20	13.16	41.21	11.76	56.31	31.93

of cations due to the root system of this crop transporting the calcium ions from the deeper layers to the upper ones. This presumption seems to be supported by the fact that in the deeper horizons no such change occurred.

The above described three types of reclamation and utilization of solonetz and solod soils must be always carefully selected and adjusted to the local conditions. The chemical type of the salt content is very important and it must be taken into account when the proper reclamation method is chosen. In the case of soda soils, for instance, the limit values of the admissible salt content in the soil profile are much lower than when the salinity is caused by neutral sodium salts.

As compared to neutral salt types, in the case of soda soils not only a lower level of salinity is required for the successful amelioration, but in order to eliminate or at least lessen the detrimental effect of sodium carbonate, the application of acid chemical amendments — as one factor of reclamation — is practically always necessary.

Conclusions

1. In the case of solonetz and solod soils where the soil profile and the top layers are capillarily linked with salty ground water, and the horizons (A_1, A_2, B_1, B_2) contain large amounts of water soluble salts, about more than 0.2 per cent in the surface layer and 0.5 per cent at a depth of 40—50 cm, the leaching out of salts and drainage are unavoidable. Chemical amendments should be applied in parallel with the above mentioned measures or afterwards. Soils belonging to this group are genetically named meadow solonetz and solod soils.

2. If the profile of a solonetz or a solod soil is only temporarily linked with ground water, and the salt content of the A, A_1 and B-horizons is lower than in the case of soils belonging to the first group, drainage is not always necessary. In these cases the application of chemical amendments (gypsum and/or others) as well as deep-ploughing and subsoil loosening may be useful. If in the B_2 and C-horizons the quantity of water soluble Na salts is not high and a considerable amount of gypsum is present, in the course of deep-ploughing it can be utilized as reclamation material. Soils belonging mainly to this group are called meadow solonetz and solod soils turning into steppe formation.

3. If the profile is not linked with ground water, its salt content (mainly in the top layers) should be taken into account when the suitable amelioration method is chosen. The climatic conditions, the possibility of irrigation, etc. are also decisive factors when the proper methods are chosen to remove the salts and to improve the physical soil properties. Chemical amendments, deep-ploughing and subsoil loosening may be used as indicated in paragraph 2. Soils belonging to this group are called mainly steppe solonetz and solod soils, and solonetz-like meadow and other soils.

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STUDIES ON THE UREA TOLERANCE IN SHEEP

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Author has studied the urea tolerance of sheep with urea products having retarding effect. The 60 g urea ratio in the rumen of the sheep gets hydrolized in an inhibited manner. Since urea sensitivity of sheep is very different individually, on the second day of the experiment one of the animals died off. It has been established that less than 60 g of the available urea mixtures are advised to be given daily to the sheep not yet being used to it. The result of the histological examination is considered only the basis of further results.

Introduction

Nowadays it is being studied how far the protein nitrogen can be supplemented in the fodder of ruminants by simple nitrogen compounds not containing protein. Among others Bates *et al.* (1961) as well as Virtanen (1963) have proved by their experiments that even the entire nitrogen requirement of the experimental ruminants could be supplied successfully with urea.

It has been stated that the cause of ammonia toxicosis occurrences is the ammonia being absorbed in a large quantity due to its quick dissolving and hydrolysis in the rumen. According to works of Rojahn (1960), Holzschuh *et al.* (1962), Juhász (1962), the urea getting into the rumen of ruminants becomes hydrolysed to a great extent within 1—1.5 hours. It is this peculiarity of urea that primarily influences the urea tolerance of ruminants.

Literary data, thus e.g. the works of Tisserand (1965) Kolesov *et al.* (1960), etc. fairly agree on sheep's being able to take up, per animal, 15 g of urea daily in two dosages, however, it has to be pointed out that individual sheep react very differently to the same amount of urea quantity. Briggs *et al.* (1960) for instance, suggest only 3—5 g of urea for one feeding because when feeding 9 g of urea, 2.2 per cent death of animals was experienced.

It often occurs that after feeding crystalline urea lesser of greater ammonia toxicosis takes place (Abonyi *et al.* 1958).

No doubt that when feeding urea, the fodder being rich in good-quality carbondydrate and the resulting volatile fatty acids render possible the formation of volatile fatty acidic salts with a buffer effect and are poorly dissociating with ammonia. Thus, as can be seen from the paper of Juhász (1962), partly the pH of rumen fluid fails to shift exceedingly towards alkaline direction, — which would favour the hydrolysis of urea, — partly the absorption of these poorly dissociating salts is slower than that of the inorganic salts of the ammonia or that of free NH_4^+. — It is also well-known that in alkaline substance the majority of ammonia is present in non-ionized form, and then it gets easier through the lipid membrane of rumen mycoderm than the NH_4^+ being of free electric charge, YOSHIDA *et al.* (1963).

Unfortunately, it is not always possible to make up fodder-rations corresponding to the above-described viewpoint, therefore the ammonia developing suddenly in large quantity, gets quickly absorbed without being utilized in the proper way by the rumen microorganisms; besides, it is also toxic.

On the basis of examinations (SZABÓ 1963) when feeding urea, the products being of retarding effect seem to be the most suitable in order to eliminate the danger of intoxication. Accordingly, such feeding would be needed when the urea gets hydrolysed by dissolving slowly in the rumen during a given time-unit, this being most suitably 2—4 hours. Thus, it can be more or less achieved that the formation of ammonia should occur at a speed proper for the building up of microbe protein because in the case of feeding crystalline urea, the developing of ammonia is quicker in the craws than the rate of protein synthesis. By this method the dissimilation and assimilation of the nitrogen substituting material can be kept in good balance. That effect, as the result of the proper preparing of urea, might render possible — besides preventing ammonia toxicosis — that the majority of the developing ammonia might be transformed into microbe protein.

For the experiments such inhibiting urea products were used (P_{16}—P_{22}) (SZABÓ 1964) one of which got hydrolysed in the sheep rumen within 2 hours while the other one during 4 hours. According to experiments of operative character, the urea products with retarding effect enhance (SZABÓ 1965) the urea tolerance of sheep which is proved by the fact that a daily quantity of 30—40 g urea could be given to a sheep without causing toxicosis. This shows that opportunity was provided to comply with the individual ammonia sensibility of sheep.

In this experiment the sheep consumed a greater quantity of urea than their actual requirement, still, no ammonia toxicosis was experienced.

From the works of AGRAWALA *et al.* (1957), TILLMANN *et al.* (1963), HOLZSCHUH (1966) it can be concluded that the simple nitrogen compounds not containing protein, are really suitable only for the partial supplementing of protein deficiency. In the present experiments author wanted to get an answer to the question what urea quantity the sheep can tolerate in the case of the inhibiting degree as mentioned above.

Materials and Methods

For experimental purposes two rumen fistular Hungarian combing merino sheep have been chosen. The experimental animals have consumed, daily in two feedings at 6 a.m. and 4 p.m., a fodder ration consisting of 700 g hay and 100 g cob-meal. The experiment was introduced by an eight-day pre-period at which time the sheep had already have the experimental fodder-ration. On the experimental days before feeding and then 1, 3, 5, 7, 9 hours after the uptake of the fodder ration and the urea-mixture containing 60 g urea and being of inhibiting effect, the experimental material was taken from the rumen fluid and from the blood of v. jugularis.

In the course of the experiments the pH of the rumen fluid was measured with the aid of pH-meter. The ammonia concentration of the rumen fluid was examined with JUHÁSZ' (1962) method, the ammonia content of blood by way of the modified micro-diffusion method of JUHÁSZ *et al.* (1958), while the urea concentration of blood-plasm according to KITAMURA *et al.* (1959). For the histological examination of liver, frozen sections and haematoxilin-eosin staining were applied.

Results and Discussion

Changes in the pH of rumen fluid:

The 1st day of experiment. Sheep No. I showed 6.61 pH value before feeding; the max. 6.96 pH was reached in the 3rd hour of urea uptake while in the 9th hour it gradually returned to the value existing before feeding.

With sheep No. II 6.53 pH value was experienced before the uptake of fodder and urea; in the 7th hour after feeding 7.12 pH value was obtained which decreased to 7.00 pH in the 9th hour.

The 2nd day of experiment. The pH value of the rumen fluid of sheep No. I was 6.59 before feeding. One hour after the uptake of fodder and urea, 7.34 pH value was experienced that reached in the 3rd hour the highly alkaline value of 8.00 pH.

In the rumen fluid of the sheep No. II 6.45 pH was established before feeding while in the 3rd hour after feeding the pH value became 6.96 pH which, however, decreased to 6.15 pH by the 9th hour.

Changes in the ammonia concentration of the rumen fluid:

The 1st day of experiment. Ammonia concentration in the rumen fluid of sheep No. I showed 51 mg/100 ml before feeding. After feeding and urea uptake that concentration gradually increased and in the 7th hour the max. concentration of 96.50 mg/100 ml was reached.

In the rumen fluid of sheep No. II an ammonia concentration of 45 mg/100 ml had been found before feeding which increased to 90 in the 7th hour and to 100 mg/100 ml in the ninth hour.

The 2nd day of experiment. Ammonia concentration in the rumen fluid of sheep No. I was 51 mg/100 ml before feeding; one hour after feeding this increased to 117.5 mg/100 ml, in the 3rd hour to 214.5 mg/100 ml and in the 5th hour it decreased to 162.5 mg/100 ml.

The ammonia concentration of the rumen fluid being 45 mg/100 ml before the feeding of sheep No. II reached the max. concentration of 140.5 mg/100 ml in the 7th hour after feeding. In the ninth hour 110.5 mg/100 ml ammonia concentration of the rumen fluid was found.

Changes in the urea concentration of the blood-plasm taken from the v. jugularis:

The 1st day of experiment. Before the uptake of fodder and urea sheep No. I showed 32 mg/100 ml concentration which increased to 47 mg/100 ml in the 9th hour after foddering.

The concentration of 32 mg/100 ml existing in sheep No. II before feeding reached the level of 49.5 mg/100 ml in the ninth hour after feeding.

The 2nd day of experiment. The urea concentration in the blood-plasm of sheep No. I was 28.5 mg/100 ml before feeding; that value increased in the 5th hour gradually to the max. 65 mg/100 ml measured on that very day.

The urea concentration of sheep No. II being 28 mg/100 ml before foraging became in the 9th hour of feeding 49.5 mg/100 ml.

Changes of the ammonia concentration in the blood of v. jugularis:

The 1st day of experiment. In blood of sheep I the ammonia concentration of blood was 125 μg/100 ml before feeding reaching in the 5th hour after feeding the level of 650 μg/100 ml and then, in the 9th hour this decreased to 195 μg/100 ml.

In the blood of sheep No. II there developed before feeding an ammonia concentration of 120 μg/100 ml and then, in the 5th hour, 650 μg/100 ml; that level decreased in the 9th hour to 380 μg/100 ml.

The 2nd day of experiment. Blood ammonia concentration of sheep No. I being 130 μg/100 ml before feeding increased to 445 μg/100 ml one hour after feeding in to 670 μg/100 ml in the 3rd hour and to 1800 μg/100 ml in the 5th hour.

Blood ammonia concentration of sheep No. II being 130 μg/100 ml before feeding became 445 μg/100 ml one hour after feeding and urea uptake 560 μg/100 ml, in the 3rd hour 810 μg/100 ml in the 5th hour. In the 7th hour after feeding the ammonia concentration in the blood of the v. jugularis decreased to 450 μg/100 ml and in the 9th hour to 255 μg/100 ml.

As shown by Fig. 1, on the 2nd day of experiments sheep died off. The symptoms of ammonia toxicosis appeared in the 4th hour following urea uptake. The sheep drew as died hanging down its head and became indifferent to its surroundings. After further 30 minutes first the hind limbs and then the whole body began to tremble more and more violently. At half past eleven it lost its balance and fell to the earth. Breathing became very heavy and foamy saliva appeared at the mouth. At 11 : 50 it got into a coma-like state and death ensued at 12. In the state of toxicosis, in the blood taken right before death, 1800 g/100 ml ammonia concentration was found.

At the section sample was taken from the liver. According to histological examination, the liver was generally plethoric, the veins were wide and the

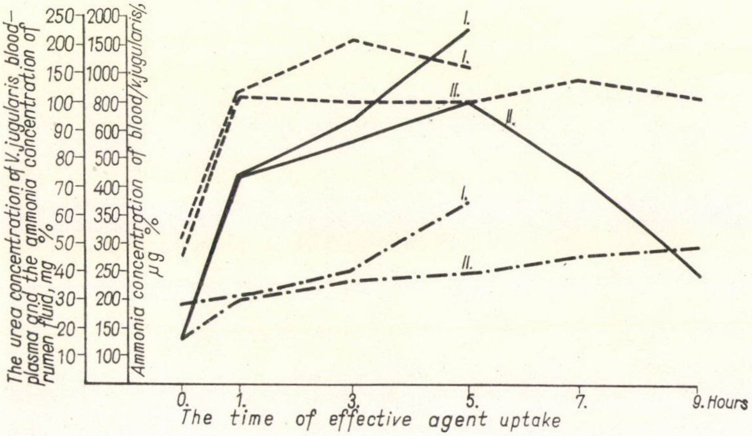

Fig. 1. The formation of ammonia concentration in rumen fluid and blood (v. jugularis) and the urea concentration of blood-plasm after the uptake of urea, in a toxic quantity, by sheep I–II. . . . Rumen fluid ammonia concentrations, ——— Blood ammonia concentrations; .—.—. Blood plasm urea concentrations

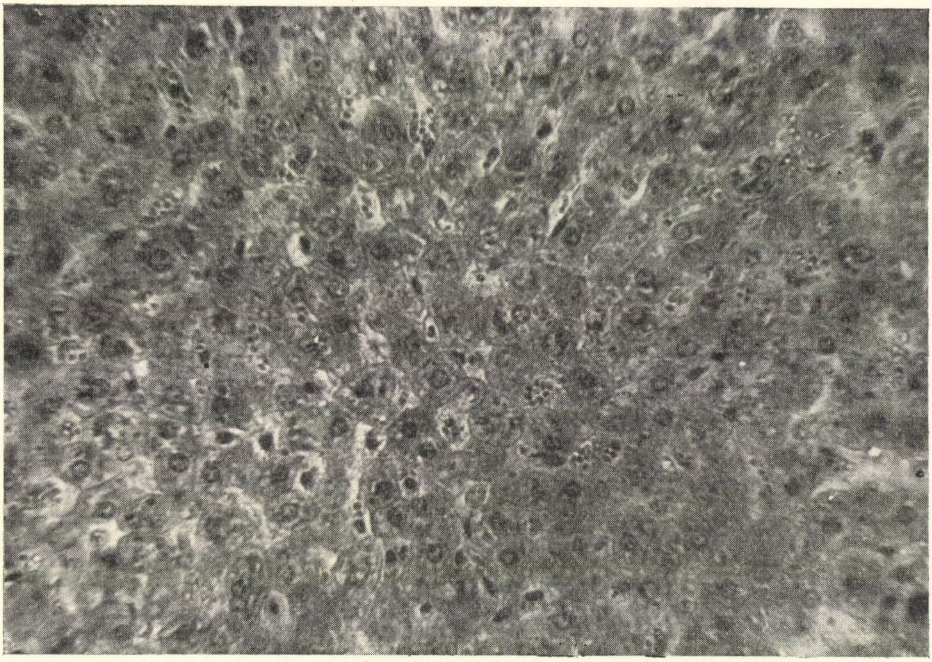

Fig. 2. Histological section of liver. 400 X haematoxilin-eosin staining

nuclei of the cells morphologically intact. Cell margins were very conspicuous. In the plasm the forming of vacuoles can be observed that were entirely irregular in their shape. The structure of the cytoplasm became decomposed. In the plasm irregular clots being stained with haematoxiline, and cloud precipitates were visible (Fig. 2).

Conclusions

In the course of the experiments an urea-product mixture being of inhibiting effect and containing 60 g urea, was introduced daily — without previous accustoming — into the rumen of each of the two experimental sheep. It has been established that, — in contrast with sheep No. II, — the urea content of urea products got more quickly hydrolysed in the rumen of sheep No. I. This is shown by the fact that in the 7th hour after introducing urea-product mixture, — and as a result of inhibited dissolving — the ammonia concentration was 96.5 mg/100 in the rumen fluid of sheep I while in sheep No. II nearly the same ammonia concentration of rumen fluid showed itself only in the 9th hour after introducing the urea-product mixture. In spite of differences, from the results of both sheep inhibited dissolving and hydrolysis became evident. Under the effect of the ammonia content in the rumen developing gradually as a consequence of inhibited dissolving, the ammonia concentration of the blood of v. jugularis increased as well in an inhibited manner.

On the 2nd experimental day one hour after the uptake of a large quantity of urea and of fodder, the pH in the slightly acidic rumen fluid of sheep I became alkaline reaching, as early as in the 3rd hour, the highly alkaline 8.00 pH value. On the other hand, sheep No. 2 reached the max. 6.96 pH value experienced during the determinations of the day only in the 3rd hour after urea uptake. From this it can be concluded that alkalescence of the rumen fluid promotes the enhanced hydrolysis not only of pure urea but also the urea content of urea products. At the same time it can be established that the foraging previous to urea uptake influences considerably the hydrolysis of urea and consequently also the ammonia quantity absorbing from the rumen as well as the ammonia — and urea concentrations, too.

Corresponding to enhanced urea hydrolysis, on the 2nd day of the experiment—taking as a basis the results of sheep No. I—it was in the 3rd hour following the introduction of urea that the max. rumen fluid ammonia concentration of the day was experienced, while sheep No. II reached the max. rumen fluid ammonia concentration of the day in the 7th hour only, being otherwise less than the previous one. The cause of it seems to be the rumen fluid being originally more alkaline, and the higher ammonia concentration of the rumen fluid. JUHÁSZ (1962) has established that if the ammonia concentration of the rumen fluid reaches the level of 120 mg/100 ml, the ammonia concentration of blood of the v. jugularis starts to increase abruptly. At this time, in most cases, the ammonia concentration of the v. jugularis exceeds the level of 500—600 μg/100 ml. The results of experiments carried out with large-quantity urea rations also prove that between the ammonia concentration of the rumen fluid and the v. jugularis there exists a correlation. After the uptake of fodder and that of 60 g urea, on the first experimental day there developed in the rumen of sheep I an ammonia concentration of 117 mg/100 ml, under the influence of which there developed in the blood of v. jugularis an ammonia concentration of 670 μg/100 ml. On the second experimental day, after the uptake of 60 g urea the ammonia concentration increased to five times, in the 3rd hour after urea uptake and in the 5th hour to 13 times as much as that existing before feeding and urea uptake. On the other hand, when introducing urea into the rumen of sheep II the max. concentration proved to be in the 5th hour, only sixfold of that before feeding. On the basis of the results it can be seen that the liver of sheep I counteracted very vigorously the effect of the absorbed ammonia that had got into the liver. After the urea concentration had reached the level of 65 mg/100 ml it became unfit for the resynthesis of further ammonia quantities. That concentration appeared in the 5th hour after urea uptake right before the animal died off. (Fig. 1) At the same time, sheep II reached the max. blood-plasm urea concentration of the day only in the 9th hour being, however, far from that of the max. concentration in the other animal.

From the results it can be seen that as a consequence of the retarded dissolving of the urea-product mixture, as opposed to toxicosis cases brought about by crystalline urea, even if definitely large quantities of the urea product are introduced, the ammonia concentration of the rumen fluid — that might cause toxicosis or maybe the death of the animal, — will develop but slowly. The ration of urea products of a mixture 1 : 1 according to the active ingredient, containing 60 g urea [weight (kg)/0.8—1 g] — that exceeds by far the urea requirement of sheep, — when introduced into the rumen of the sheep without being accustomed to it previously, causes death rarely and from time to time only. I has to be mentioned that when feeding it in groups, the experimental sheep consumed the product mixture containing 40 g of urea only slowly or not at all. From this it can be concluded that under normal conditions it does not come to the uptake of 60 g urea.

The histological examination of liver served only as a starting point for further experiments.

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RELATION OF PARENT MATERIAL AND ENVIRONMENT TO THE CLAY MINERALS OF SOME INDIAN SOILS OF PERHUMID TROPICAL ZONES

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The study correlates the mineralogical composition of clays isolated from two Indian soils on different rocks and climates with that of the coarser separates and attempts to elucidate a reaction-mechanism leading to the formation of clay mineral in them under the given parent material and climatic conditions. The study brings out that the ferromagnesium silicates and micas in fine sand are associated with Mg-bearing secondary mineral (Pasighat) and illite (Cherrapunji) respectively, in clay. Where the clay mineral is either magnesium bearing 2 : 1 type (Pasighat) or illite (Cherrapunji), the soil exchange complex contains a high proportion of alkaline earth cations particularly Mg^{2+}, and K^+ respectively, in dynamic equilibrium with the weatherable alkaline earths or K-bearing primary silicates. This explains the stability of illite in highly leached and acid soil of Cherrapunji, the stability being ensured by high content of exchangeable K^+ as constantly being replenished from the breakdown of K-bearing primary minerals (muscovite) contained in the soil.

Introduction

Since primary minerals constitute the original source of all chemical elements, the mineralogy of the non-clay fractions of the soil comprising a number of rock derived minerals with different degrees of stability and chemical activity are thought to provide and maintain a particular ionic environment in the soil with requisite ions by their breakdown under a particular type of climatic condition. The mineralogical make-up of the weathered comminuted particles of the parent material as represented in sand and silt must, therefore, bear a relation to the secondary minerals in clay, the formation of which depends largely on the ionic composition of the weathering zone yielded by parent material. The present study, third in the series, attempts to bring out such a correlation. It includes soils of perhumid tropic having different parentages, the composition of which are examined petrographically (Datta—Adhikari 1968) in order to understand the role of the weatherable rock-forming minerals as stated.

Material and Method

Experimental materials were collected from the perhumid tropical regions of India. One is a leached flat alluvial (of Dihang river) soil from Pasighat, the other, a highly weathered old alluvium soil of Cherrapunji (the world's highest rainfall area). The basic informations in details, about the soils, climate, parent rock and fundamental data on these profiles are described in a preceding paper (DATTA—ADHIKARI 1968).

This is a part of a broader study of the genesis of clay minerals in typical Indian soils and is outlined in the same way as the other foregoing investigations.

Results

Base exchange behaviour of the whole soil. Data in Table 1 shows that in Pasighat soil, the dominant exchangeable ions are calcium, magnesium and potassium. The percentage adsorption of Ca^{++} is as high as 62.77 and that of Mg^{++} is 46.40 distributed in decreasing and increasing order down the profile, respectively. These high contents of Ca^{2+}, Mg^{2+} and also of K^{+} in this soil indicate that within the soil material, primary weatherable alkaline earth-bearing and K-bearing minerals occur as dominant reactive constituents in equilibrium with secondary minerals in clay. Such equilibrium suggests the presence of 2 : 1 layer lattice mineral containing calcium and magnesium, and also micaceous clay mineral in this clay.

In the highly perhumid region of Cherrapunji, the soil is characterised by low c.e.c. in spite of fairly high clay content (c. 38.15 per cent). Hydrogen ions form the major proportion of exchangeable ions, followed by potassium. An appreciable amount of K^{+} in exchange sites may suggest the presence of mica-like clay minerals in clay.

C.E.C., surface area and Y-value. As shown in Table 2 the clays of Pasighat in the various layers of the profile are characterised by large internal surface areas. Such values are often met with in highly degraded illites. Exchange capacities as well as Y-value (18.4) are also indicative of the same. From a close observation of the data, it is of interest to note that the surface amenable for glycol adsorption becomes very low on heating the clay to 600 °C, so that the internal surface becomes relatively very high in comparison with the total surface. This clearly discloses that a large interlayer space is suppressed by heating and suggests the presence of the layer lattice mineral with a large interlayer space. This type of high values of internal surface associated with an illite-like total surface (cf. Table) indicates the existence of vermiculite (BOWER—GESCHWEND 1952), though present in small quantity.

The total surface area of Cherrapunji soil clays and the corresponding glycol retention values compare with those usually met with mica-like minerals (DYAL—HENDRICKS 1950). The internal surface areas also indicate illitic mineral, possibly of a degraded type. Furthermore, c.e.c. together with Y-value of 10.5 corroborates the contention that illite is the predominant mineral in this clay.

Chemical properties of soil clays. Pasighat clays are likely to contain 2 : 1 layer lattice mineral, as judged from the value of silica content and SiO_2/Al_2O_3 ratios (Table 3). The content of K_2O indicates the presence of illitic mineral in

Table 1

Base-exchange properties of the whole soil (oven dry basis)

Moisture region	Sample	Depth in inches	Percent adsorbed cations					Base saturation at pH 7.0 (percent)	C.E.C.* at pH 7.0	pH (water)
			Ca	Mg	K	Na	H			
	Pasighat, Siang,	0— 7	62.77	20.94	10.33	6.16	0	100	16.2	6.15
Highly humid	N. E. F. A.	7—29	43.93	34.64	6.81	4.61	10.01	89.99	13.9	5.90
to perhumid	28° 4′ N	29—50	46.79	33.08	6.43	4.12	9.58	90.42	12.5	5.85
	95° 21′ E	50^+	35.90	46.40	13.70	3.70	0	100	15.3	5.83
	Cherrapunji, K. and	0— 6	15.01	7.67	26.10	3.93	47.28	52.72	8.0	4.40
	J. hills, Assam.	12—24	11.98	5.07	12.34	4.82	65.78	34.22	6.8	4.80
Highly perhumid	25° 15′ N	48—72	18.76	9.66	24.37	6.27	40.94	59.06	5.3	4.60
	91° 44′ E									

* NH_4-exchange capacity

Table 2

Specific surface, C.E.C. and Y-value of soil clay

Sample	Depth in inches	Total surface		External surface		Internal surface		C.E.C. meq/100 gm.	Y-value (surface layer)
		gm./gm.	sqm./gm.	gm/gm.	sq.m/gm.	gm./gm	sq.m/gm.		
	0— 5	0.0714	230.3	0.0036	11.6	0.0678	218.7	38.9	
Pasighat	7—29	0.0710	229.1	0.0014	4.6	0.0696	224.5	22.9	18.4
	29—50	0.0630	203.2	0.0034	10.9	0.0596	192.3	27.2	
	50^+	0.0711	229.2	0.0031	10.1	0.0679	219.2	31.6	
	0— 6	0.0576	185.8	0.0304	98.1	0.0272	87.7	32.9	
Cherrapunji	12—24	0.0621	200.4	0.0281	90.7	0.0340	109.7	31.2	10.5
	48—72	0.0489	157.6	0.0227	73.2	0.0261	84.4	34.2	

clay. In addition some magnesium bearing secondary mineral is also suggested from the appreciable content of MgO.

Low contents of SiO_2 and low SiO_2/Al_2O_3 ratios suggest the presence of kaolinite in Cherrapunji clays. A good content of K_2O shows that illite is also present.

Minerals in soil clays. X-ray Study. The principal mineral in Pasighat clay, as X-ray data shows, is illite. The diffuse nature of (001) basal spacing in the region of 10 A substantiates the fact that illite present is degraded. The (001) spacing sharpens on heating. KCl treatment also collapses this diffuse pattern to some extent. These observations do confirm the degraded nature of the mineral. This clay contains, in addition, an appreciable amount of kaolinite as shown by the well defined spacing at 7A (001) and the subsequent basal spacings. The X-ray diagram shows, in addition, a weak reflection at 13.67 A (0—7″) and 14.02A (7—29″). This is glycerol stable indicating the absence of montmorillonite. It collapses to 9.6—10.2 A on heating to 600 °C showing that it is not due to chlorite. The 14.02 A (or, 13.67A) component is therefore ascribed to vermiculite. KCl treatment resulting in a collapse to 10.2A (or 9.6A) attests vermiculite.

In Cherrapunji, the (001) spacing of illite is very diffuse at 9.9A region which remains so even on heat treatment. It has also a considerable "tail" of long intensity on the long spacing side. All these point to the degraded illite. The weak 7A reflection disappearing on heating to 600 °C shows the presence of a small amount of kaolinite.

Differential thermal analysis. Differential thermal curves (Fig. 1) of Pasighat clays show considerable water loss below 100 °C and gradual but continuous endothermic reaction up to 850 °C where dehydration is substantially complete. The above features correspond to those of vermiculite (BARSHAD 1950, WALKER 1951). The endothermic reactions at about 535° C and 640° C may be due to kaolinite and illite. The d.t.a. curves for 7—29 "and the 29—50" samples are somewhat different from those of the 0—7 "and 50"+ samples. In the former the endothermic peaks below 100 °C are broad and shallow, indicating the possible presence of degraded illite or interstratified illite-vermiculite (COLE—HOSKING 1957).

The differential thermal diagrams (0—6 "and 48—72") of Cherrapunji clays (Fig. 1, E, G.) are almost flat up to 450 °C indicating no low temperature water loss for hygroscopic or interplanar water and manifest deep and sharp dehydroxylation endothermic reaction features at 579—590 °C (0—6″) and 567—573 °C (48—72″). The above features bring out the presence of kaolinite with illite in them (ADHIKARI 1958). A small endotherm at about 950 °C followed by an exotherm after 1000 °C also suggests some 2 : 1 layer lattice mineral as noted by JACKSON (1956). The latter in this case is obviously an illite.

The curve for 12—48″ sample, however, exhibits a gradual but small

Table 3

Elemental analyses of soil-clays (oven dry basis)

Sample	Depth in inches	SiO_2 p.c.	Al_2O_3 p.c.	Total Fe_2O_3 p.c.	TiO_3 p.c.	CaO p.c.	MgO p.c.	K_2O p.c.	Ignition loss p.c.	SiO_2/Al_2O_3 molar ratio	Free oxides of iron as FeO_3 p.c.
Pasighat	0—7	38.16	30.17	14.09	0.47	0.62	0.55	3.52	13.42	2.1	0.89
	7—29	41.64	31.02	10.22	1.46	0.26	1.48	4.91	10.90	2.3	1.55
	29—50	45.10	26.60	8.73	0.83	0.76	2.18	4.09	11.71	2.9	2.12
	50^+	43.81	27.92	9.49	0.48	0.11	1.96	5.36	10.87	2.7	1.06
Cherrapunji	0—6	34.39	25.55	21.59	1.04	0.65	0.55	3.12	13.31	2.3	1.52
	12—24	30.87	33.85	13.85	1.17	0.70	0.60	5.40	12.94	1.5	1.63
	48—72	31.62	43.88	5.33	0.48	0.62	0.70	4.45	12.81	1.2	2.00

Table 4

Partial chemical analysis of coarse silt (oven dry basis)

Sample	Depth in inches	C.E.C. meq./100 gm.	K p.c.	Mg p.c.
Pasighat	0—7	4.8	1.6	1.11
	7—29	3.0	1.7	0.99
	29—50	5.6	2.1	0.99
	50^+	4.8	1.2	0.78
Cherrapunji	0—6	0.17	3.1	0.89
	12—24	0.43	4.9	0.67
	48—72	0.43	3.6	0.56

loss of water at low temperature followed by the main (OH) water loss reaction endotherm between 555 °C and 579 °C. The latter reaction is very weak here giving off a broad and endothermic effect. Unlike the other two, there is no high temperature endo- or exotherm. From the character of these thermal reactions, it appears that degraded illite is the major mineral constituent in this layer.

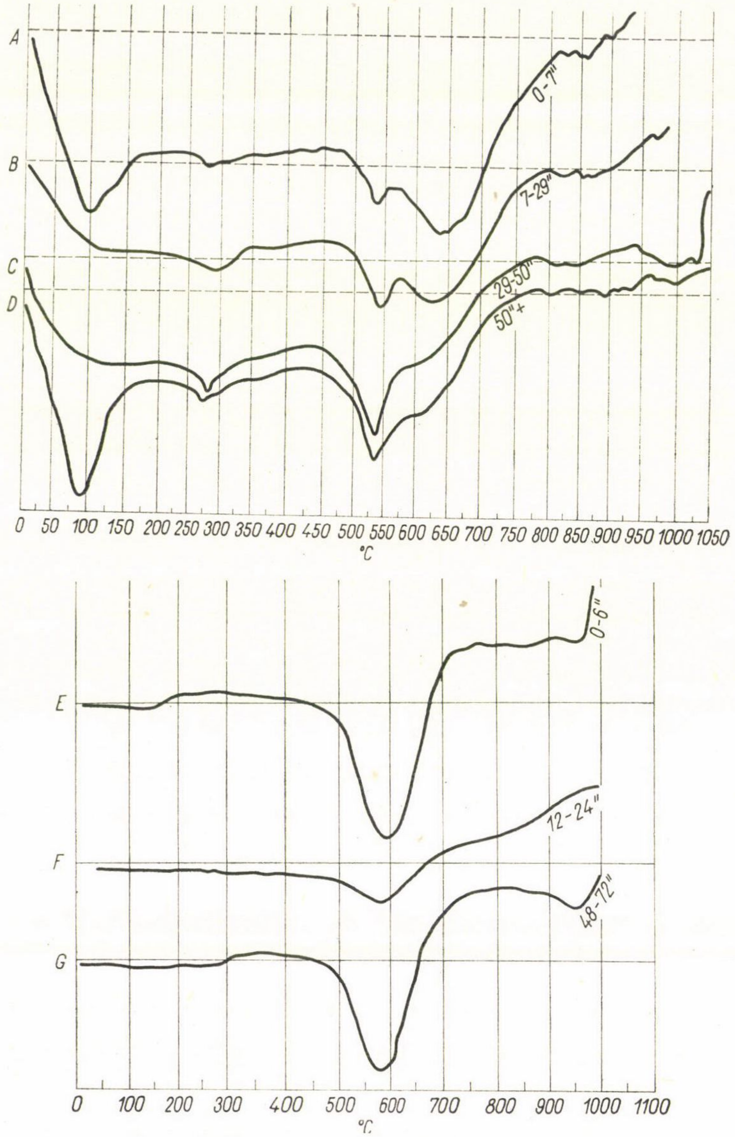

Fig. 1. Differential thermograms of H-clays. (A, B, C, D, Pasighat soil clay, 0–7", 7–29", 29–50" and 50"+, respectively, E, F, G, Cherrapunji soil clay, 0–6", 12–24" and 48–72", respectively)

Summing up the results, Pasighat clay contains illite, kaolinite and vermiculite in order of decreasing abundance, while Cherrapunji contains dominantly illite with a small amount of kaolinite. Relative quantity of each constituent, however, varies a little in different layers.

Mineralogy of Coarse Silt (20—50μ)-partial chemical analyses data are given in Table 4.

X-ray study discloses that quartz is the predominant mineral in Pasighat silt. Amongst felspars, microcline is present in fair abundance together with a minor quantity of plagioclase. Mica is present in appreciable amount. Potassium (cf. Table) is assigned to K-bearing mineral and thus bears out X-ray findings. The (001) mica spacing (at 10.96A) being longer than the usual spacing, indicates that the mineral is either hydrated or probably interstratified. C.e.c. values also support this contention.

In Cherrapunji silt, quartz is the principal primary mineral. Besides, it contains mica in appreciable amount. Neither potash feslpar nor plagioclase occurs. Since K-felspar is seemingly absent, mica alone is the source of the potassium (Table 4). In view of the absence of any other magnesium bearing mineral, magnesium can similarly be assigned to mica. The low content, however, point to the fact that mica is more likely a muscovite. As indicated by X-ray, mica appears to be hydrated because of having its (OO1) spacing at 10.799 A).

Discussion

Pasighat. Pasighat soil has developed on Dihang alluvium of Pleistocene and Recent (cf. geol. description) under highly humid climate. The provenance study (DATTA—ADHIKARI 1968) discloses that this alluvium material underlying the soil has been fed with the materials mainly from metamorphic rocks, of which calc-schist, a basic metamorphic is a major constituent.

Among the primary silicates occurring in the light crop of fine sand, moderately altered plagioclase mainly oligoclase type, occurs in appreciable proportion. K-felspars fairly altered in fair, and muscovite in small amount, are also present. Ferromagnesium minerals—amphiboles and chlorites, occurring abundantly characterise the heavy crop.

The principal minerals in coarse silt are quartz, K-felspars and mica in order of decreasing abundance. Only a minor amount of plagioclase occurs. This shows that the mineral has suffered considerable weathering in this size range.

The weathering condition is fairly intense under high rainfall and as a result the soil reaction becomes acid. Despite this perhumid weathering condition, Ca^{++} and Mg^{++} ions constitute the major exchangeable cations followed by K^{+}. It is reasonable to suppose that the exchangeable Ca^{++} and Mg^{++}

resist the leaching effectiveness of the rainfall because Ca-plagioclase and Mg-bearing amphiboles and chlorites occurring in appreciable amount in soil, are replenishing calcium and magnesium leached from the exchange sites. A similar argument holds good with exchangeable potassium.

Illite dominant in clay appears to be associated with the altered soda-calcic felspars and is, possibly, stabilised by K^+, occurring as exchangeable ions, while vermiculite seems to be associated with weathering of amphiboles and chlorites in sands. In view of the basic nature of the latter mineral, such alteration under acidic weathering seems plausible (Droste—Bhattacharya—Sunderman 1962). Calcium and magnesium, particularly the latter, occurring largely in soil exchangeable complex, tend to stabilise this vermiculite in clay.

The occurrence of kaolinite as the second important mineral in clay is expected in view of the acid leaching weathering condition and presence of appreciable quantity of felspars. Ionic composition in the soil weathering zone constantly being enriched by calcium and magnesium, may be acting as an inhibiting factor blocking the formation of kaolinite which otherwise would have been predominating under the climatic condition existing in this soil. A part of Si and Al released by felspars in such a medium when Mg^{++} is high is perhaps going to form vermiculite-type mineral (Barshad 1964) or, illite in presence of K^+ ions as already stated.

Cherrapunji. The soil is formed *in situ* from parent rock of Cretaceous and Tertiary sediments underlain by Archeans (cf. Geol.) under highly perhumid condition of weathering. The soil is mostly influenced by the parent material composing of components derived dominantly from acid granite and also from a minor mixed metamorphic component containing garnet-sillimanite-schists and basic metamorphic (Datta—Adhikari 1968).

Acidic reaction. The large proportion of exchangeable H^+ and marked alteration of plagioclase in sand separate indicate that the soil has undergone a pronounced pedochemical weathering process. Low silica in clay and free oxides of iron associated with it also point to the same.

Fine sand contains a large quantity of muscovite. Amongst felspars, plagioclase occurs in moderate amount in an appreciably altered state, while K-felspar is almost absent.

In the coarse silt size fraction quartz predominates. Mica, more probably muscovite, occurs in fair abundance. Felspars, neither of the two species is present. The total extinction of plagioclase denotes its instability in this size fraction and indicates its weathering.

Large exchangeable K^+ seems to be associated with muscovite mica which, as stated, occurs largely specially in fine sand. The latter mineral on weathering and decomposition is possibly maintaining a potassium environment in the weathering zone, which might cause K^+ ion dominance in the exchange complex of the soil. K^+ ions appear to maintain, therefore, a dynamic equilibrium between the primary potassic mineral and the secondary clay mica. This equilibrium may explain the formation and stabilisation of illite in the soil clay even in intense leaching weathering conditions prevailing in Cherrapunji.

Although weathering conditions seem to be congenial to the formation of kaolin, the latter could not form in appreciable quantity possibly because of the paucity of felspars, particularly, K-felspars. Whatever amount is formed, might be at the expense of plagioclases. In other words it may be said that whatever little quantity of Si and Al these felspars (main source of Si, Al) release in the weathering system goes primarily to the formation of illite under the prevailing potash rich ionic environment. Only the remainder of Si and Al goes to form kaolin, which as a consequence, could not form appreciably.

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VARIA

RED PEPPER KALOCSAI E 15

(Kalocsai E 15 fűszerpaprika)

Taxonomic place: Capsicum annuum L. convar. *longum* (DC) Terpó provar. *rectum* Fingerh. conc. *kalocsaiense* My. subconc. *pendens* My. (Terpó 1965).

Origin: Obtained by individual selection from a local variety of the Kalocsa district

Beginning of breeding: 1948, Kalocsa

Breeders: Gabriella Schmidt and György Komlóssy, Tápiószele—Budapest

State qualification: State certified improved variety, 1959

General characterization: A non-hot red pepper of nice colour, high colouring content, with safe and high yielding capacity suitable for producing good-quality milling product.

Morphological description:

Root system: The abundantly developed root system penetrates into soil about as deep as 60 cm.

Shoot system: The knarred branch systems stand close, they are stiff and generally as high as 45—50 cm. The number of branch systems is 3—4.

Stem: It is composed of dark yellowish-green internodes being moderately ribbed.

Foliage: The leaves are set somewhat losely on the shoot system. The leaf blades are mediocre broad, lance-shaped ovate; the apex is tapering, the shoulder being rounded off; the leaf is olive-green, its surface is shiny and smooth.

Flowers: The corolla is whitish yellow.

Fruit: As to its form, mostly the ideal red pepper type (conical calyx tube, the fruit's line downwards is straight) is prominent (63,5 per cent); a considerable type of form (16,3 per cent) is also the straight-line fruit that is, however, characterized by a flat calyx tube (SCHMIDT 1959). Fruit length is 8—12 cm, its width below the calyx is 3—3,7 cm. The downwards line of the fruit is conical tube-like, the apex is a conical top, the surface is smooth, shiny. Number of veins: 2—3. During ripening its colour is olive green, in mature state this becomes flame-red, while after drying it is deep-red. — 80.9 per cent of the harvested yield is generally healthy, of A. I. Dry material content is 19 per cent, hygroscopical rate is 12.5 per cent, stain content: capsanthin 5.23 g/kg (KOMJÁTI 1963). The fruit is drooping.

Seed: Flattened, roundish kidney-form with a diameter of 3—4 mm, golden yellow in colour. Of air-dry weight of the fruit 26.7 per cent falls to the seed.

Biological characters:

Germination and seedling development: optimum temperature 20—25° C.

Vegetative period: long; maturity occurs late; satisfactory yield can be obtained only by an early planting of well-developed seedlings.

Water-requirement: Dry conditions are well tolerated; irrigation does not increase the yield considerably; quality is not deteriorated by it either (KAPÁS *et al.* 1965).

Resistance to diseases: to diseases it is fairly resistant.

Farm technology requirements:

Seeding: In the second half of March

Planting: 50 × 50 cm spacing, three seedlings in the first half and middle of May.

Soil requirement: It yields more favourably on heavy soil, however, sandy soil in good nutritive power is also suitable; on clay soils that can get warm easily it yields more abundantly.

Productivity: Average yield 93,8 q/ha; the yield is produced at three picking times as follows: first picking 52,9 per cent, second picking 37,7 per cent, third picking 9,4 per cent (KOMJÁTI 1963). Of the air-dry weight 68,8 per cent falls to the fruit pericarp, quantity of the veins is 4,5 per cent, while the rest is made up by seeds.

Region of cultivation: The most suitable area for growing is the district of Kalocsa; however, when planted early, it can be grown in the district of Szeged, too.

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Prepared at the National Institute of Agrobotany, Tápiószele.

GY. MÁNDY

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REGULATING INFLUENCE OF SOME POTENTIAL PYRIMIDINE BASE ANALOGUES ON THE NUCLEIC ACID SYNTHESIS IN BEAN LEAVES

The incorporation of pyrimidine base analogues into nucleic acids has been studied extensively, but little attention has been devoted to their influence on the incorporation of natural nucleobases. The study of this problem became justified by the suggestions of **Osborne** (1965) and **van Overbeek** *et al.* (1966, 1967), stating that the cytokinin-active purine derivatives act in the plant through the consequence of their accumulation in the transfer-RNA (**Fox** 1964, 1966, 1967, **Letham** *et al.* 1967), and after the indirect effect of stimulation of nucleic acid biosynthesis.

The following compounds were tested by us in our incorporation studies: uracil, 2-thiouracil, 6-methyluracil, 5-azauracil, 6-azauracil, 5-azacytosine, 6-azacytosine, 2-thio-Δ-hydantoinacetic acid, β-(6-azauracil-5-yl)-propionic acid, N-formylbiuret and glyoxylic acid semicarbazone. These compounds are known from the chemical literature. They may be regarded as potential antagonists of the natural pyrimidine bases or as potential antagonist-precursors, as in the case of the last four compounds.

Discs were taken from intact Pinto bean (*Phaseolis vulgaris* L.) leaves and were floated first for 18 hours on the surface of a 100 p.p.m. solution of the corresponding base analogues, than for 3 hours on the radioactive solution containing adenine-8-^{14}C and uracil-2-^{14}C, respectively. The specific activity of the nucleobases were 2.98 mci./mmole for adenine and 3.70 mci./ mmole for uracil. After repeated purification the radioactivity of the TCA insoluble RNA was determined by means of liquid scintillation. Table 1 shows the experimental data in c.p.m. and in per cent.

Based on the nucleobase-equivalency principle, these results indicate that while some compounds are strong inhibitors of RNA synthesis, others increased the rate of incorporation into RNA and /or DNA. Stimulants of both DNA and RNA biosynthesis are N-formylbiuret and 6-methyl-uracil. In the case of the former compound our finding is in accordance with the result of **Škoda** *et al.* (1964), demonstrating that N-formylbiuret stimulates the incorporation of orotic acid into RNA in the case of Ehrlich ascites in pregnant mice. Special attention has to be paid to the action of 5-azauracil and β-(6-azauracil-5-yl)-propionic acid. These compounds stimulate the incorporation of adenine, and as a consequence the simultaneous synthesis of both RNA and DNA, to a much greater extent than RNA-synthesis when characterized by the incorporation of uracil only. Based on these results it can be supposed that these two compounds exhibit their biological activity on the level of DNA-independent RNA synthesis. The activity of 5-azauracil against *Escherichia coli* (**Šorm** *et al.* 1960, **Škoda** *et al.* 1962) can be based on this fact and it seems probable that β-(6-azauracil-5-yl)-propionic acid acts in an analogous way.

6-azauracil, glyoxylic acid semicarbazone, 5-azacytosine, 6-azacytosine and 2-thio-Δ-hydantoinacetic acid acting on a similar way on nucleobase-incorporation, apparently inhibits both the DNA-dependent and DNA-independent RNA biosynthesis. The biochemical mechanism of action of these compounds is unknown, yet it can be hypothesized that the potential pyrimidine base analogues investigated by us exhibit their biological effectivity on nucleic acid synthesis by incorporating into transfer-RNA.

The strongest stimulation of both RNA and DNA biosynthesis was achieved by 6-methyluracil (pseudothymine). This compound is a structural isomer of thymine and can be regarded as a potential antagonist of both uracil and thymine. Its biological effect has been studied tentatively only (**Schlegel** *et al.* 1954, **Dekker** 1962, **Matolcsy** *et al.* 1969). There is a possible correlation between cytokinin activity and nucleic acid biosynthesis which is indicated by investigations with 6-methyluracil as a potential cytokinin active substance (**Pozsár—Matolcsy** 1968). These studies are in progress.

A detailed study of the biological effect and biochemical activity mechanism of the most active compounds, by comparative examination of the stimulation (N-formylbiuret) and inhibition (2-thio-Δ-hydantoinacetic acid) processes seems to be justified.

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Table 1

Incorporation of radioactive carbon labelled adenine and uracil into TCA-insoluble nucleic acid of intact Pinto bean leaves after floating for 18 hours on a 100 p.p.m. solution of the corresponding pyrimidine base analogue and for 3 hours of radiobiological exposition, expressed in c.p.m. and per cent

Water content of leaves 68 per cent; the average deviation of the average values does not exceed ±8 per cent

Potential pyrimidine base analogues	Radioactivity in the insoluble nucleic acid fraction			
	adenine-8-^{14}C		uracil-2-^{14}C	
	c.p.m./100 mg fresh weight	%	c.p.m./100 mg fresh weight	%
water	103 200	100	74 400	100
uracil	123 600	119	58 700	78
2-thiouracil	80 400	77	52 300	70
6-methyluracil	108 600	105	91 500	122
5-azauracil	103 200	100	87 200	117
6-azauracil	57 000	55	40 800	54
5-azacytosine	63 600	61	60 900	81
6-azacytosine	70 800	68	50 200	67
2-thio-Δ-hydantoinacetic acid	3 000	2	2 300	3
β-(6-azauracil-5-yl)-propionic acid	121 200	117	63 100	84
N-formylbiuret	118 800	115	107 200	144
glyoxylic acid semicarbazone	21 600	20	15 700	21

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QUALITY OF WINTER WHEATS

Breeding work is based on the knowledge of varieties. This means that only varieties whose characteristics are thoroughly known should be used in crossing. Breeders get generally acquainted with the varieties in hand sown small plots, or sometimes by field experiments.

Quality is one of the most important character of varieties. Nevertheless, relatively few data are available in this respect. In our paper detailed data of a 2 year-quality-trial performed with 82 winter wheat varieties are presented.

The examinations were carried out with mechanically sown experimental plant material at the National Agrobotanical Institute, Tápiószele.

Soil of the experimental plot was of chernozomic loam with alluvial origin and a thick fertile surface (60–80 cm). Green crop in both years (1965 and 1966) was pea and 500 kg/cad. hold mixed fertilizer was applied each year.

According to the meteorological data (Table 1) the total amount of precipitation during the vegetative period (October–July) was nearly the same in both years (569–566) with some variations in monthly distribution.

The total number of hours of solar radiation during the vegetative period was considerably higher in 1966.

Quality of winter wheats was characterized by determining the "complex qualitation index" introduced by us (Pollhamer 1967). In addition to complex qualitation indexes we present the data also in detail, as breeders need to know the part-factors of quality as well.

Among varieties examined in 1965 (Table 2) the first 15 varieties given in the succession of their complex qualitation index are of exceedingly good quality. They are excellent both in the quantity and quality of their gluten content. The lower gas retaining capacity of Bánkúti 1201 and the relatively poor crude protein content of Bezostaya 1 (14 percent) are exceptions, but other qualitative features of these varieties are also highly favourable.

Varieties No. 15–28. belong to the good quality- and medium quality groups respectively. Varieties are characterized mainly by a high protein content, hence they may be good parent plants in producing new varieties with higher protein contents.

The last 12 varieties are considered to be of bad quality on the basis of their qualitative features. These varieties generally cannot be taken into account as parent plants.

In 1966 partly previous year's varieties, partly new ones were examined. Complex qualitation indexes of previous year's varieties as well as the values of part-factors were lower in

Table 1

Meteorological
Tápiószele

Year	Precipitation	I.	II.	III.	IV.
					Monthly
1901—50	Mean	28	31	34	45
1964	Total precip. mm	4.8	23.9	30.9	15.8
1965	Total precip. mm	44.0	5.0	55.0	58.0
1966	Total precip. mm	57.0	29.0	53.0	54.0
					Hours of solar
1901—40	Mean	64	90	145	205
1964	Hours of solar radiation	55.3	113.5	60.5	219.1
1965	Hours of solar radiation	48.1	102.3	135.5	106.4
1966	Hours of solar radiadion	44.9	92.9	157.9	188.8

1966, but qualitative succession — except for the variety Langedoc — did not change considerably. This year the excellent quality-group consists of the first 9 varieties. Varieties over No. 23. proved to be of poor quality.

Among the new varieties the early Soviet Rannaya 27 was found to be of remarkably good quality. It is excellent for both quantity and quality of its gluten content. Among the new varieties Pannónia, Funelló and Ranka III have relatively high protein contents, but their gluten quality is poor.

It is noticeable that the variety Moisson which gives fairly good pharinographic values is not good either for the quantity or the quality of its protein content.

In the tables we gave 10 qualitation indexes of varieties. On this basis, parent plants suitable for improving the quality can be properly selected. However, on the basis of other

data
1964—1966

V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
distribution							
58	64	58	51	44	49	52	40
33.7	79.3	68.0	72.0	52.0	76.0	15.0	76.0
64.0	110.0	66.0	41.0	14.0	1.0	136.0	62.0
42.0	52.0	80.0	69.0	17.0	39.0	87.0	58.0
radiation							
262	279	304	278	200	129	75	47
255.7	325.1	311.9	263.2	200.6	126.5	80.0	25.9
130.0	156.6	180.3	181.1	191.8	207.9	49.5	35.1
293.5	257.3	281.7	295.1	234.9	168.4	43.4	54.2

data it is known that the variational range of qualitative features changes from variety to variety. Therefore, quality-improving varieties have to be selected for quality before crossing.

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Prepared at the Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár

Zs. Pollhamer

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Table 2

Quality data of winter wheat varieties
Martonvásár, 1965

Names of varieties	Complex qualitation index	Crude protein %	Wet gluten %	Zeleny value	Gas retaining capacity, min	Farinograph index	Volume of bread, cm³	Water absorbing capacity %	Ratio of bread form	Extension capacity of gluten mm	Hull content %
1. Benvenuto Mayo	270	15.40	41.0	40.0	350	87.5	476	62.0	2.6	1.5	9.79
2. Record	240	14.70	39.9	39.0	203	82.7	450	59.0	2.2	2.5	8.94
3. Garant	220	15.75	38.6	36.0	196	92.1	430	61.0	2.5	4.0	9.01
4. Belocerkovskaya 198	210	15.05	39.9	41.0	172	96.4	353	62.0	2.5	3.0	9.05
5. U 8/85	210	15.75	41.1	35.0	236	100.0	390	62.0	2.6	2.0	10.29
6. Bezostaya 1	200	14.00	35.5	40.0	182	85.2	452	59.0	2.1	1.0	9.79
7. Dawbul	200	14.35	38.0	40.0	115	81.7	432	60.0	2.5	1.5	8.90
8. Ottawa	200	15.75	43.0	39.0	135	70.5	441	64.0	2.9	5.5	9.62
9. Magdaléna	200	15.50	43.6	45.0	117	87.5	419	60.0	2.4	4.5	11.29
10. Autonomia	200	16.10	41.8	35.0	172	78.4	437	63.0	2.5	4.5	10.03
11. Bánkuti 1201	200	16.80	46.8	35.0	63	82.7	425	67.0	2.2	3.5	10.07
12. U 8/47	200	14.70	39.9	35.0	252	100.0	390	61.0	2.3	3.5	10.22
13. Mironovskaya 808	190	14.70	37.4	40.0	210	96.4	403	60.0	2.6	2.0	10.98
14. K 388	180	15.40	43.6	35.0	171	84.2	418	61.0	2.5	6.5	10.61
15. K 344	180	15.05	38.0	31.0	110	87.5	405	61.0	2.7	2.5	8.88
16. Strubes kreuzung	170	15.05	41.0	37.0	35	68.0	484	59.0	2.2	5.5	9.47
17. Fertődi 293	170	15.40	43.6	38.0	88	84.2	397	61.0	2.4	7.0	10.44
18. Cenad 512	170	16.80	45.5	39.0	61	70.2	425	62.0	2.9	7.0	10.81
19. Skorospelka 3b	170	15.75	39.3	38.0	50	79.2	411	58.0	2.2	5.0	9.52

20. Cimarron	165	14.70	40.5	37.0	70	57.7	425	60.0	2.6	4.5	8.86
21. Pawnee	160	15.75	41.1	35.0	22	62.9	429	60.0	2.9	6.0	8.40
22. Fertődi 33	160	16.10	44.9	38.0	98	87.5	369	62.0	2.6	6.0	12.01
23. T. M.	150	15.40	38.6	36.0	34	58.5	448	58.0	2.3	6.5	9.26
24. Prof. Hermann Sz.	150	14.00	36.1	38.0	63	78.0	416	54.0	1.6	2.5	9.80
25. Z. Imperial	130	16.80	40.5	30.0	103	75.6	336	63.0	3.2	7.5	10.44
26. Ainta	130	15.50	41.9	30.0	30	63.5	362	58.0	2.1	6.0	9.97
27. Autarchia	130	14.35	36.1	41.0	51	59.0	376	57.0	2.4	2.0	9.41
28. Floress	130	13.30	31.2	33.0	28	79.2	374	57.6	1.9	2.5	9.90
29. Branitzka kolkunow	125	14.70	38.6	25.0	135	67.0	399	57.6	2.6	6.0	9.49
30. Kozlovec 3	125	13.65	34.9	29.0	90	61.3	391	55.0	1.8	2.5	9.90
31. Jules Tezier	120	13.30	33.0	31.0	35	54.8	390	55.0	1.7	3.5	9.01
32. Knox	115	14.70	40.5	38.0	17	64.7	280	57.0	2.5	6.0	9.56
33. Kecskeméti 175—198	110	14.70	35.8	44.0	58	78.0	317	58.0	2.6	3.5	11.22
34. B 33	110	15.40	41.8	31.0	20	50.6	438	66.0	3.6	5.5	11.00
35. Languedoc	110	12.20	31.8	37.0	75	82.7	321	53.0	1.8	3.0	9.46
36. Etoile de Choisy	100	13.65	34.9	30.0	35	57.3	345	54.0	2.3	5.0	9.43
37. Jubilejna III.	85	12.95	33.0	26.0	19	45.6	295	56.0	2.5	3.5	9.58
38. Flamingó	60	12.95	34.3	26.0	19	30.5	370	55.0	3.2	10.0	9.30
39. San Pastore	50	13.65	33.6	25.0	25	36.5	278	54.0	3.4	8.5	10.54

Table 3

Quality data of winter wheat varieties
Martonvásár, 1966

Names of varieties	Complex qualitation index	Crude protein %	Wet gluten %	Zeleny value	Gas retaining capacity, min	Farinograph index	Volume of bread, cm³	Water absorbing capacity %	Ratio of bread form	Extension capacity of gluten mm	Hull content %
1. Rannaya 27	235	16.80	41.80	37.0	116	78.8	536	63.0	1.8	9.0	10.41
2. Bezostaya 1	190	14.00	33.69	30.0	162	88.8	440	63.0	2.1	2.0	9.18
3. Martonvásári 2609	180	14.70	34.32	31.0	226	88.8	368	61.0	2.2	2.5	9.88
4. Magdalena	180	14.00	33.07	30.0	141	87.5	548	62.0	1.9	5.0	10.36
5. Languedoc	160	14.35	31.20	38.0	158	90.3	391	55.0	1.6	1.5	11.23
6. H 59/3	160	16.80	38.68	44.0	61	81.3	408	59.0	1.9	5.0	11.81
7. Mironovskaya 808	150	13.30	30.57	28.0	175	100.0	440	57.0	2.0	2.5	9.56
8. Heurtebise	145	15.40	40.56	32.0	149	86.9	434	65.0	2.5	6.5	11.60
9. Karcagi 344	140	14.70	34.32	29.0	115	81.7	376	63.0	2.4	4.0	10.44
10. B. 11	130	14.70	36.81	24.0	54	44.2	411	66.0	2.2	7.5	10.61
11. H 59/1	130	14.70	35.56	37.0	26	62.9	400	59.0	1.9	3.5	11.10
12. Glutinoso	130	15.75	38.68	33.0	28	62.6	360	61.0	2.1	5.5	10.61
13. Skorospelka 3b	125	15.05	38.68	31.0	43	62.4	445	57.0	1.9	8.0	10.76
14. Martonvásári C 18	120	14.35	34.32	33.0	68	56.0	350	57.0	1.9	4.0	9.92
15. H 59/2	120	16.10	38.06	40.0	49	68.0	355	60.0	2.0	5.0	12.66
16. Strubes Kr. 21c	120	15.40	38.68	29.0	51	71.0	390	60.0	2.4	6.0	11.29
17. Fertődi 293	110	14.35	36.19	26.0	87	76.7	396	65.0	2.6	7.0	12.00
18. Panonija	110	16.10	39.31	33.0	37	65.0	304	54.0	1.8	7.5	11.66
19. T M 850	110	15.05	36.81	26.0	25	51.0	358	59.0	2.4	4.0	10.71
20. Norin 16	110	14.70	35.56	28.0	70	49.0	366	58.0	1.9	7.5	10.78

21. Funello	100	16.45	42.43	28.0	22	35.3	308	58.0	2.3	8.0	12.80
22. Autonomia	95	15.40	38.06	29.0	96	60.2	354	56.0	2.3	5.0	12.60
23. Moisson	90	13.65	30.57	26.0	56	77.3	362	53.0	2.0	5.5	10.39
24. Sambo	90	12.95	28.70	20.0	23	41.9	312	54.0	1.8	7.5	9.05
25. H 52/1	90	13.30	31.20	31.0	52	65.7	312	57.0	2.1	3.5	11.27
26. Dobruzsanka	90	11.90	30.57	28.0	82	44.4	368	57.0	1.8	5.0	10.76
27. H 52/2	85	14.70	34.94	30.0	28	55.3	333	57.0	2.0	6.0	11.98
28. Rada II.	85	15.05	35.56	28.0	25	44.0	308	58.0	2.0	7.0	11.90
29. Horpácsi 457	85	13.65	31.20	30.0	24	52.8	288	60.0	2.6	4.5	10.58
30. Etoile de Choisy	80	13.65	32.44	21.0	43	45.6	333	54.0	2.3	7.0	10.03
31. Vuka	80	14.70	36.19	29.0	28	62.9	333	61.0	2.8	6.0	12.29
32. Bolgár 1064	80	14.00	34.32	24.0	36	50.6	295	57.0	2.3	7.0	10.95
33. K.×P. T.	70	12.95	30.57	25.0	44	43.2	312	56.0	2.4	4.5	11.12
34. Ranka III.	70	16.10	39.31	24.0	21	31.7	320	57.0	2.8	10.0	12.15
35. Dunavka	68	14.00	31.87	25.0	25	51.2	291	53.0	2.1	4.0	11.86
36. Lonigo 1	68	13.30	33.68	23.0	26	51.1	334	55.0	2.2	6.5	12.20
37. NS-116	65	13.30	31.20	23.0	26	33.6	250	53.0	1.8	5.5	10.78
38. San Prospero	65	14.70	35.56	23.0	26	39.8	291	56.0	2.2	5.5	12.60
39. Floress	65	13.30	29.95	25.0	40	65.0	337	58.0	2.0	2.0	13.00
40. Ve selopodoljanskaja 499	65	12.95	34.32	15.0	18	28.3	291	56.0	2.3	8.0	11.10
41. Champlein	58	13.65	33.69	20.0	20	46.7	325	59.0	2.4	10.5	11.60
42. Flamingo	50	12.60	29.32	17.0	24	22.2	312	55.0	2.4	9.5	11.20
43. San Pastore	47	14.00	34.32	20.0	21	27.7	312	54.0	2.3	9.0	12.60

THIN-LAYER CHROMATOGRAPHIC TEST OF LINDEN FLOWERS

Linden flowers are much in request in popular therapy. These are used as diaphoretic, diuretic, against hoarseness, as a component of stomachic and neurotonic teas, and less frequently as spasmolytic and foment (Halmai—Novák 1963). On the basis of his own experience Leclerc (1935) sets great value in its effect on arteriosclerosis.

The drug contains a little volatile oil, mucilage, sugar, flavonoides, saponine and tannin (Luckner—Bessler—Schröder 1965, Halmai—Novák 1963).

The Hungarian pharmacopoea (Pharmacopoea Hungarica 6. 1967) excludes *Tilia argentea* Desf. (= *Tilia tomentosa* Moench.) while approves of using as drugs flowers of *Tilia cordata* Mill., *T. platyphyllos* Scop. as well as of its subspecies (*T. rubra* D.C., *T. grandifolia* Ehr., *T. obliqua* Host., *T. caucasica* Rupr.) and varieties picked at the time of flowering together with the bracts. These carry into the commerce marked linden flowers (kőhárs).

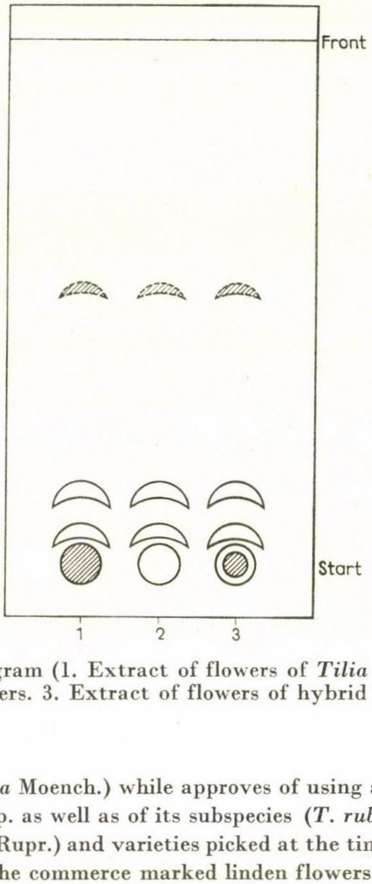

Fig. 1. Thin-layer chromatogram (1. Extract of flowers of *Tilia argentea* Desf. 2. Extract of linden flowers. 3. Extract of flowers of hybrid limetrees)

The identification on a morphological basis is difficult, especially at the hybrids. To decide on their pharmacopeal usability a qualitative thinlayer chromatographic test of the flavonoide compounds was worked out.

0.20 g of the ground (1 mm mesh) drug was extracted with 70 per cent ethanol for half an hour at room temperature, meanwhile shaken repeatedly. The extract was filtered through filter paper and used directly for further examination.

A slurry consisting of 20 g "Merck" Kieselgel G and 45 ml 0.1 M borax solution was spread over five glass plates (20 × 20 cm) of thin-layer chromatographic test by means of Stahl's spreader. The plates were dried at room temperature and used on the next day. 0.02

ml of the extract was applied. The developing solvent mixture was toluene-ethyl acetate-glacial acetic acid (30: 50: 14: 6). The length of run was 11 cm. The plates dried with electric hand-drier after the development of the chromatogram, were heated at 100 °C during 10 minutes. The chromatogram was evaluated in U.V. light. As it is seen in Fig. 1 a marked difference is shown in the spot at the start among the various lime-trees. With *Tilia argentea* Desf. it fluoresces in bright blue, while with the linden flowers in yellow or yellowish green, but never in blue. Linden flowers taken from different places (Vilmány, Tiszavasvári, Sály, Kaposvár, Kemecse, Babócsa, Mosonmagyaróvár) were used as control. With a hybrid originated from Hajdúböszörmény and morphologically resembling *T. argentea* Desf. a spot fluorescing in blue and surrounded by a yellow fluorescent ring was seen at the start (Fig. 1).

Proven by this test the method meets the requirements of qualifying control. It has a great advantage: it needs little material. In addition it is quick, since — provided the plates are prepared — the test can be performed in one and a half hour.

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Prepared at the National Institute for Agricultural Quality Testing, Budapest.

Zs. Lassányi

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THE FIRST HUNGARIAN ENCYCLOPAEDIST

In the 17th century Hungary was characterized by historical conditions totally different from those in the western European countries where balance of political forces developed gradually, and the stimulation of Reformation as well as secularization became effective in economic, social and intellectual life. Thus, while this century meant the beginning of bourgeois development, prosperity and new scientific discoveries for western Europe, Hungary was divided into three parts and fought continually both external enemies and internal difficulties. One part of the country had been occupied by the Turks since 1526, and another part was ruled by the Hapsburgs. Life of the population — which could hardly bear economic and other burdens of foreign oppression anyway — was made even more difficult and uncertain by barbaric cruelties of the Turks and the aggressive counter-reformation policy of the Hapsburg court. The third part of Hungary, the relatively independent principality of Transylvania being the freest part of the country at that time either from political, or from intellectual and religious points of view, and a starting point of frequent wars of independence, fought for the liberation of the oppressed parts. This difficult era still gave many scientists — great pioneers — to Hungarian culture history. One of them was János Apáczai Csere (1625—1659).

Very little is known of his family affairs and school years. He probably attended elementary school in his native village, Apáca, and secondary school at Kolozsvár. In the autumn of 1643 he was admitted to the University of Gyulafehérvár where he studied until 1648.

Financial foundation of the University was laid by the enormous donations of Gábor Bethlen, Prince of Transylvania, and its high educational level was ensured by cultured foreign professors. According to the evidence of contemporary records the salaries of professors here were higher than anywhere else in Europe, except Holland.[1] As for reputation and European fame, the most important foreign professor was J. H. Alsted (1588–1638). He had already died before Apáczai came to Gyulafehérvár, but his ideas and works – first of all his encyclopaedia – exerted a decisive effect on Apáczai. Alsted's successor, J. H. Bisterfeld (1605–1655) was also a believer of encyclopaedic knowledge and his influence on Apáczai is proved by the introduction of the Hungarian Encyclopaedia.

MAGYAR
ENCYCLOPÆDIA.
Az az,
MINDEN IGAZ ES HASZNOS
Bölcſeségnek ſzep rendbe foglalá-
ſa és Magyar nyelven világra botſátáſa.
APATZAI TSERE JANOS
által.
SENEC. 64. EPIST.
Etſi omnia à veteribus inventa eſſent: hoc
tamen ſemper novum erit, uſus & inven-
torum ab aliis ſcientia & diſpoſitio.
Adami
ULTRAJECTI,
Ex Officinâ JOANNIS à WAES-
BERGE, cIↃ IↃ C LIII.

Fig. 1. The title-page of Apáczai Csere's "Magyar encyclopaedia" ("Hungarian Encyclopaedia")

Fig. 2. Memorial tablet of the Hungarian students trained in Utrecht

There are also very few data of the years spent by Apáczai at Gyulafehérvár. It is known that he finished his studies here in the summer of 1648, and his good reputation was proved by the fact, that he was invited to rectorship at the well-known school of Marosvásárhely. However, he did not accept the invitation as he had already the prospect of continuing his studies at foreign academies. It was in that very year, indeed, that the bishop, István Geleji Katona, sent the eminent student to Dutch universities at the expense of the Church.

We have to mention here briefly the role the foreign study tours played in the intellectual life of that century. At the beginning of the 17th century at least 90 per cent of the pop-

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[1] Imre Bán: Apáczai Csere János. Bp. 1958. 46. p. 121. notes.

ulation of Hungary was already protestant,[2] but the political and economic situation outlined above, and the Hapsburgs' counter-reformation policy that became more and more aggressive during the century did not allow protestant high-schools to rise to the same level as that of the western academies. Thus, after having finished their studies at domestic schools, talented young men went to foreign universities to obtain scientific degrees. Then, when they returned they became professors in Hungarian Colleges or rectors of the major secondary schools. It is also interesting, that, while in the previous century majority of the students attended the universities of Germany,[3] in the 17th century the centre of gravity shifted to Dutch universities. The reasons for this phenomenon were partly the destruction of the Thirty Years' War in Germany, partly perhaps the fact, that by that time Hungarian reformation had joined the Calvinist doctrines and turned, therefore, with interest to Holland. For example, between 1623 and 1789 the Franeker Academy itself had 1200 Hungarian students.[4] Also a considerable proportion of the Hungarian protestant theological literature of that time — in addition to the dissertations of numerous Hungarian students studying at Dutch universities — was published in Dutch printing houses — owing to counter-reformation in Hungary. It is of interest to mention here, that at the end of the century (1675) thirty Hungarian preachers and teachers sent to the galleys for their protestant belief were liberated by the Dutch admiral De Ruyter; furthermore, before and after that the Dutch ambassador in Vienna, Gellért Hamel Bruininx informed his government on cruelties of the Hungarian counter-reformation and used his influence to intervene in the Hapsburg court on behalf of the Hungarian protestants.[5] This traditional Dutch-Hungarian intellectual and friendly relationship was maintained for centuries through considerable Dutch foundations endowed for Hungarian students; it even exists today — especially in the Hungarian Calvinist Church.

Let us have a look at the university life of the century in Holland. The Dutch economic life made an enormous progress from the beginning of the century by shipping and trading all over the world. This rapid economic development soon produced its cultural results too. Intellectual freedom on one hand, and university professors' salaries highest in Europe on the other — attracted many scientists and intellectual notabilities. At the beginning the universities — which were opened one after the other — competed for the students, since even the very high level of Dutch intellectual life did not require so many universities.[6] Thus, Hungarian studients arriving in great numbers received a hearty welcome and were granted various favours. For example, Hungarian students were allowed to attend lectures, take part in disputes and defend their diploma work at Dutch universities without being matriculated, i.e. paying school-fees. There is an interesting record at Groningen: "Gratis inscriptus est, quia Hungarus" (Matriculated free of charge, being a Hungarian).[7] Though in the 17th century majority of the Hungarian students studied with the financial aid of Hungarian patrons, from 1641 onwards the 25.000 thaler by the Van Frankendaal foundation was also at their disposal.[8] Voetius Gisbertus (1598—1676), the famous university professor who initiated the foundation in question, was himself on friendly terms with the Hungarian students, sometimes even supported

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[2] Sándor Bíró—Mihály Bucsay, etc.: A magyar református egyház története (History of the Hungarian Calvinist Church). Budapest. 1949. 32. p.

[3] Majority of the Dutch universities was established only in the 17th century. The first of them, the University of Leyden was established in 1575.

[4] Lajos Segesváry: Magyar református ifjak az utrechti egyetemen (Hungarian Calvinist youths at the University of Utrecht). Debrecen, 1935. 10. p.

[5] A magyar református egyház története (History of the Hungarian Calvinist Church). 113—119, 122—124. p.

[6] The University of Utrecht had only 35 matriculated students between 1636 and 1643, and there were years (e.g. 1657) when this number fell to 16. Imre Bán: cf. 102. p.

[7] Debreceni Prot. Lap 1902, 40. p.

[8] Imre Bán: cf. 102. p.

them financially. Sympathy and respect towards Hungarian students were probably explained by the fact, that these young men remained faithful to their belief amidst the cruelties of counter-reformation.

Apáczai was matriculated at the University of Franeker on 22 July, 1648. With the date of 5 September, 1648 we find his name in the register of the University of Leyden,[9] but it is not known how long he stayed in Leyden. He probably went to live in Utrecht as early as in 1649; though he matriculated at the University only in 1650. He was allowed — as we have mentioned before — to attend lectures without being enlisted. Apart from the events of the English revolution, the greatest experience was for him that he got acquainted with Descartes' ideas. In spite of the violent literary disputes and interdictions Descartes' ideas took root in Holland earlier than in any other country. Regius (Le Roy), Descartes' follower, who was even more radical and consequent than his master in explaining the questions of natural sciences, was also a professor in Utrecht at that time. As we shall see later, besides Descartes, he also had a great influence on Apáczai. The years spent in Holland brought Apáczai significant scientific results. His first public academic performance took place in March, 1650 when he presented Voetius Gisbertus' disputation as a respondent.

In April, 1651 he became doctor of divinity[10] in Harderwijk and in the same year, on 30 September married a civic girl from Utrecht: Aletta van der Maet. According to some sources Apáczai was proposed in 1652 to be a professor in Utrecht. However, as an alumnus of the Transylvanian Church he had to ask his bishop for a permission to remain. The bishop's letter calling him home at the end of 1652 was probably an answer to his request. It is possible, however, that Apáczai himself did not want to remain in Holland, as at that time he was already writing the first Hungarian encyclopaedia for his nation. Undoubtedly this work was the greatest conceptions of the years he spent in Holland: "Magyar Encyclopaedia, azaz Minden igaz és hasznos Böltseségnek szép rendbe foglalása és Magyar nyelven világra bocsátása" (Hungarian Encyclopaedia, or all true and useful wisdom arranged systematically and given to the world in Hungarian). Ultrajecti, Ex officina Joannis a Waesberge, 1653.[11]

In the preface Apáczai himself told about what induced him to write this work. It was already at Kolozsvár that his conviction — inspired by his teacher, András Porcsalmi's example — of the necessity of an encyclopaedic knowledge developed. Scientific justification of systematization was given him in university lectures delivered by Bisterfeld at Gyulafehérvár. He saw in Alsted the example to follow and at the academies of the Netherlands he set himself to survey the order of sciences and — by summarizing the works of the most important authors — to try to construct an encyclopaedia. In Utrecht he got acquainted with technical books written in western languages and read them with "envious amazement" — as he himself said. This was what made him write the following words: ". . . the nation which borrows everything through foreign languages is extremely unfortunate and more miserable than any other nation . . . This sight being night and day before my eyes gnawed at my conscience so much, that it often did not let me sleep, turned my mind from my studies and concentrated all my thoughts to the question: how could I improve the conditions of my country."[12] As these lines, too, show Apáczai recognised the material and intellectual backwardness of his country with astonishment and clearly saw the misery of being forced to acquire knowledge in foreign languages. "For this very reason, it is my firm resolution — if God allows me to

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[9] Imre Bán: cf. 25. p.

[10] Jenő Zoványi: A harderwijki egyetem magyar hallgatói (Hungarian students of the University of Harderwijk). ITK. 1891, 433. p.

[11] 1653 given as the date of publication is a mistake; it was published in 1655.

[12] János Barta—Tibor Klaniczay: Szöveggyűjtemény a régi magyar irodalomból (Text collection from the old Hungarian literature). Vol. 1. Budapest. 1951. 555. p.

live for a few more years — not to die until I interprete all sciences in Hungarian" — he wrote.[13] The birth of this idea was a very important moment in Hungarian culture history.

Let us have a closer look at the Encyclopaedia itself. Its structure is more logical than that of Alsted's encyclopaedia. The Latin preface is a thorough humanistic work divided into 3 parts: reasons of writing the work, elucidation of the character and sources of the book and finally, advices and encouragement for its use. It is not surprising that Apáczai wrote a Latin preface to the Hungarian Encyclopaedia, since he wanted to explain his intentions to the scientific world. The Encyclopaedia itself consists of 11 chapters; proportions of the individual parts are remarkable. Philosophy is dealt with on about 26 pages, mathematics and natural sciences on 257, social sciences on 74 and theology on 47 pages,[14] that is, the work is of highly natural science character. Survey on the sources of the Encyclopaedia is also of interest. Apáczai did not intend to give anything original, his most difficult task was even the selection of the appropriate authors. The content of the Encyclopaedia is composed mostly of the works of Descartes, Ramus, the Ramist Scribonius, the Cartesian Regius, the Puritan Fennerus and Amesius, the politically highly progressive Althusius and the encyclopaedist Alsted. Copernicus' name was mentioned in the list of the sources primarily as an open confession indicating the author's heliocentric views. Ramus and Scribonius had become somewhat obsolete at that time, and some of Alsted's works were also pseudo-scientific, but at least six of the eight authors were leading scientists of their age. By its literary form the Encyclopaedia is a text-book — as Apáczai himself said in the introduction — intended to give a scientific review on the level of that time; thus, in the modern sense of the word it is not an encyclopaedia.

There is no way here to discuss every chapter of the Encyclopaedia in detail, therefore they will only be enumerated and the part for natural sciences will be studied more closely.

Part I starts with Descartes' epistemology followed by chapters on dialectics and logics (Parts II and III), mathematics and geometry (Parts IV and V). Part V. has an interesting "addition" in which Apáczai refused the existence of indivisible atoms and insisted on the Cartesian principle of infinity and material uniformity of the universe. Part VI. written on astronomy proves Apáczai's thorough absorption in this discipline. It is very important, that in this work of his written for usage as a text-book he presents the heliocentric conception of the universe, while most of his Hungarian contemporaries either refused or mentioned it as a hypothesis even at the end of the century. This part of the Encyclopaedia is the first astronomical work written in Hungarian, and constructed on a high level with much initiative. Part VII. contains the natural sciences. It consists of 47 chapters: physical geography, physics and chemistry (1—16) followed by general biology and physiology (17—27), then psychology (28) and medicine (29—38), and finally a description of the "three domains of Nature": zoology (39—41), botany (42—45) and mineralogy (46—47). The chapter on physics has the peculiarity of being the first to present in Hungarian some rules of Descartes' famous optics. The subjects of biology and physiology start with Chapter 17. The chapters of zoology can be divided into three large groups: anatomy, physiology and taxonomy.[15] After the definition of animal the parts of animal body are described, that is, a primitive anatomy is given. Then follows a description of the physiological processes of "animals with souls" distributed as: a) processes of growing (nutrition, digestion, blood circulation — with Harvey's description of pulmonary- and systemic circulations —, respiration, excretion and generation), b) processes of perception and motion. "Centre of the processes of perception and motion is the brain" which he describes after Regius. The subsequent discussion of perception and the sense organs reflects the anatomical and physical knowledge of that time. One of the most interesting

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[13] Text collection. . . I. 556. p.

[14] Imre Bán: cf. 171. p.

[15] Raymund Rapaics: A magyar biológia története (History of Hungarian biology). Budapest, 1953. 15. p.

parts of the Encyclopaedia is Chapter 28.; it is an extract of the Cartesian psychology which stands out in sharp contrast to the scholastic pneumatology generally accepted in the 17th century. After the chapters of biology and physiology those of medicine follow. Apáczai was not a pioneer in Hungarian medical literature, he could rely on remarkable traditions. The subsequent zoological chapters — on the contrary — were the first products of Hungarian zoological literature.[16] The Hungarian Encyclopaedia describes 116 animals: 47 terrestrial-, 43 aerial- and 26 aquatic ones. There is no use to look for any kind of taxonomy in this part, even animals of the same species are mentioned quite independently.[17] The reason why Apáczai did not find better sources was the relative backwardness of 17th century's zoology. Until the end of 17th century — and even much later — zoological works fell within the scope of fiction rather than of science. This first Hungarian "zoology" is also a collection of interesting, colourful and sometimes amusing animal descriptions of which we give here some examples. "The elephant is a clumsy quadruped of frightful size . . . It is tame and obedient . . . its cleverness and goodwill are nearly human, that is why it is said to be able to learn to speak and write . . . It understands the native language of its birth-place . . . Elephants respect the rising sun . . . they bury their dead. They love man very much. They yearn to be respected so much they would sooner die than being abused."[18] Then there are statements like: "The crocodile weeps when seeing a man. Serpents are very much afraid of nude humans and by no means bite them. Earth never takes in a serpent that killed a man by biting him. Salamanders live in fire. There is a kind of tree in Scotland the fruits of which become ducks when falling into the sea. Swans sing sweetly before dying. Ostrich digests iron. Turtle doves go in their widowhood everywhere alone, moan and never sit on green branches. The gaze of the basilisk kills. Delphins love children very much, speak as humans and enjoy the name Simon."[19] There are, however, parts in the zoological chapters of the Encyclopaedia that are valid even from the point of view of modern science, for example the description of the life of bees. Apáczai cannot be reproached with the mistakes and deficiencies of the zoological part, as there was no scientific work in the middle of the 17th century which could have given him more precise information. As for Hungarian zoological literature, he even did a pioneer work. A modern summarization of the history of Hungarian biological research evaluates Apáczai's Encyclopaedia as follows: "In Hungary János Apáczai Csere was the first to summarize the knowledge about life and living creatures. This work is a great step in the history of Hungarian sciences. It was the first time that a comprehensive scientific review got within reach of Hungarian readers."[20]

The subsequent botanical part consists of four chapters and gives descriptions of 81 plants. In the botanical part Apáczai did not give anything new, there had been earlier Hungarian specialists of this branch of science. This part is completed by two chapters on mineralogy (46—47). Metals are classified entirely according to the conceptions of alchemy. Stones are divided into: precious stones, rare but not very precious ones, and no precious stones. Finally the magnet is described and some phenomena of magnetism known at that time are enumerated. Part VIII. deals with human work and its results. It was in this part that Apáczai included descriptive geography, architecture and economics. It is of interest that Apáczai agreed with the bold political theory of English Puritan thinkers about tyranny. This theory discussed in a text-book was a daring step in Transylvania in 1654. It was also here that he wrote about one of the major demands of Puritan fights: the necessity of establishing schools of mother tongue. The order of sciences is closed by theology.

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[16] János Hanák: Az állattan története és irodalma Magyarországon (History and literature of zoology in Hungary). Pest, 1849. 18. p.

[17] János Hanák: cf. 20. p.

[18] Magyar Encyclopaedia (Hungarian Encyclopaedia) 203—204. p.

[19] Imre Bán: cf. 255—256. p.

[20] Raymund Rapaics: cf. 13, 14. p.

Now we shall try to give a short summary of the natural scientific views of the Hungarian Encyclopaedia. One of the most conspicuous features is that it represents highly progressive conceptions mixed with mediaeval traditions. Apáczai accepted the Cartesian cosmogony, Copernicus' system, agreed with Descartes' instructions in certain fields (e.g. optics). He constructed thorough and modern astronomy, physiology, psychology, medicine from the available sources. On the other hand, thousand-years-old theories, obstinately surviving ideas were also given space in his work. Apáczai's real greatness is in the fact that in a backward country and at a time when almost exclusively a theological way of thinking was domineering, he formulated the theories of e.g. blood circulation or magnetic declination with scientific objectivity.[21] Thus, he succeeded in attaining his aim: to interprete the knowledge of his age in his native language — even if here and there not quite perfectly. This work was a novelty in the Hungarian literature of that time, and both with its language and style is one of the most prominent relics of our past; history of the development of our scientific language should always start with the name of János Apáczai Csere.

In 1653 Apáczai came home from Holland. It must have been difficult for him to make this decision, as he could reckon upon wealth and university career in Holland, while in Transylvania all he could expected was uncertainty. But a disciple of Puritan theology and ethics could not have decided differently. Aletta van der Maet followed her husband to the unknown remote country. When at home Apáczai was appointed to the College of Gyulafehérvár as a professor, where after the death of the Puritan Bisterfeld (1655) Isaac Basire became rector. Isaac Basire, former court-chaplain of Charles I. of England, Anglican canon and archdeacon who escaped from the English revolution, readily accepted the safe and well-paid post. Basire who hated any clearical trend of progressive nature tried to convince the Prince of their dangerous effects by referring to the example of the English revolution. On 24. September, 1655, at a ceremony of final examination where the Prince was also present with his faithful followers, Basire delivered a speech against independentism and Puritanism. Apáczai in his answer declared his Puritan conviction; therefore the Prince publicly deprived him of his post, and his friends — with Zsuzsanna Lorántfy, the Prince's mother herself among them — managed to obtain for him a post of a schoolmaster at the secondary school of Kolozsvár only in the summer of 1656. In his opening speech he emphasized again the necessity of establishing elementary-, secondary- and high-schools instructing in the mother tongue, and referred to the example of Holland where not only in the smallest villages but even in the colonies there were schools.[22]

Meanwhile, the political situation in Transylvania became entirely chaotic and uncertain. The abdicated Prince and his successor fought for power, then in August, 1658, Turkish and Tartar hordes invaded Transylvania, set fire to many towns and slaughtered the population. The College of Gyulafehérvár, the Library and Archives of the Prince were destroyed. Kolozsvár was spared only by paying ransom. After the fighting had been over in September, 1658, Ákos Barcsay was made Prince of Transylvania by the Turk. In the second half of 1659 Transylvania became again the scene of fights between the two princes, and the vicinity of Kolozsvár, too, changed hands twice.

The anxieties of those times had a fateful effect on the severely consumptive Apáczai. His last work "Philosophia naturalis" — the Porcsalmi's copy of which was left to us — was also a text-book, or more precisely a "dictate". This work is a systematizing summary of natural sciences completing the content of the Encyclopaedia. The book is written on 204 pages and consists of four parts: philosophy, arithmetics, geometry and physiology. The physiological part is more exact and detailed than that of the Encyclopaedia, and anatomical data too

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[21] Imre Bán: cf 272. p.
[22] Imre Bán: cf. 467. p.

are more fully contained in it. A comparison of the two works shows that Apáczai learnt a lot after he had written the Encyclopaedia, and his knowledge became more systematic in many respects. The Encyclopaedia is — of course — a greater work, but the Philosophia naturalis is also a remarkable relics of the old Hungarian instruction of natural sciences.

Other literary products of Apáczai's Transylvanian years: "Magyar Logikácska és Fortius tanácsa" (Little Hungarian logics and advices of Fortius) was published in 1654, though written already in Holland, and "Disputatio de mente humana" (Discussion of human mind) in 1658. In this latter he denies Regius' famous doctrine, namely, that soul (thinking) is only a mode of existence of the body. There is some evidence of several other works by Apáczai published in 1658, but the works themselves have lost.

Apáczai died in 1659 on New Year's Eve. On the occasion of his funeral his pupils and friends published a booklet with poems celebrating him as the reformer of the College who "while staying up and working untiringly for the cause of literature, throwing light upon sciences, sighed his own existence slowly out."[23]

The last data on his wife were recorded on 20. February, 1660. She must have survived her husband only by a couple of years, due probably to her loneliness and home-sickness in this foreign country to her.

Memory of Apáczai remained alive throughout the centuries. The Encyclopaedia have always been a treasure in College- and private libraries alike, and fulfilled the task it was meant for by its author: have taught thousands of Hungarians eager to study.

A succession of his pupils whose scientific career started under his leadership as well as the survival and influence of his ideas prove the great value of this humble life.

V. I. Hanekamp-Kovács Sebestény

REACTION OF CRAMBE ABYSSINICA HOCHST. EX R. E. FREES TO SOME PLANT VIRUSES

The susceptibility of *Crambe abyssinica* Hochst. ex R. E. Frees (Family: *Cruciferae*) to certain plant viruses was described by Thornberry—Phillippe (1965). *Crambe abyssinica* was found unsusceptible to ampelamus virus (AV) and cucumber mosaic virus (CMV). Also negative virus assays were provided by *Vigna sinensis* (L.) Endl. cv. *Blackeye* cowpea. Plants of *Crambe abyssinica* were symptomless carriers of tobacco atypical mosaic virus (TAMV), tobacco mosaic virus (TMV) and of an orchid virus (OV), isolated from diseased *Cattleya** plants. Whereas TMV became systemic in inoculated plants, TAMV occurred in low concentrations in the inoculated leaves only. Turnip mosaic virus ((TuMV) induced systemic symptoms on *Crambe abyssinica*.

The aim of this investigation was to test whether *Crambe abyssinica* reported by Thornberry—Phillippe (1965) as susceptible to TAMV, TMV, TuMV and OV, is a suitable test plant to be used with potato virus Y (PVY), potato virus X (PVX), potato aucuba mosaic virus (PAMV) and tobacco necrosis virus (TNV), and whether or not it can be employed for the separation of CMV strains.

In our experiments the following strains were used: X^G of PVX (Horváth—Beczner 1968), four strain groups of PVY (Horváth 1966a, b, 1967a, b), isolate GW—104 of PAMV (Hollings 1966), strain b of TNV (Szirmai 1961), strain Ul of TMV (Siegel and Wildman

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[23] Imre Bán: cf. 538. p.

* Orchid viruses (for literature see: Thornberry—Phillippe 1964, Burnett 1966, Francki 1966, Thomson—Smirk 1967, Corbett 1967 and Thornberry *et al.* 1968).

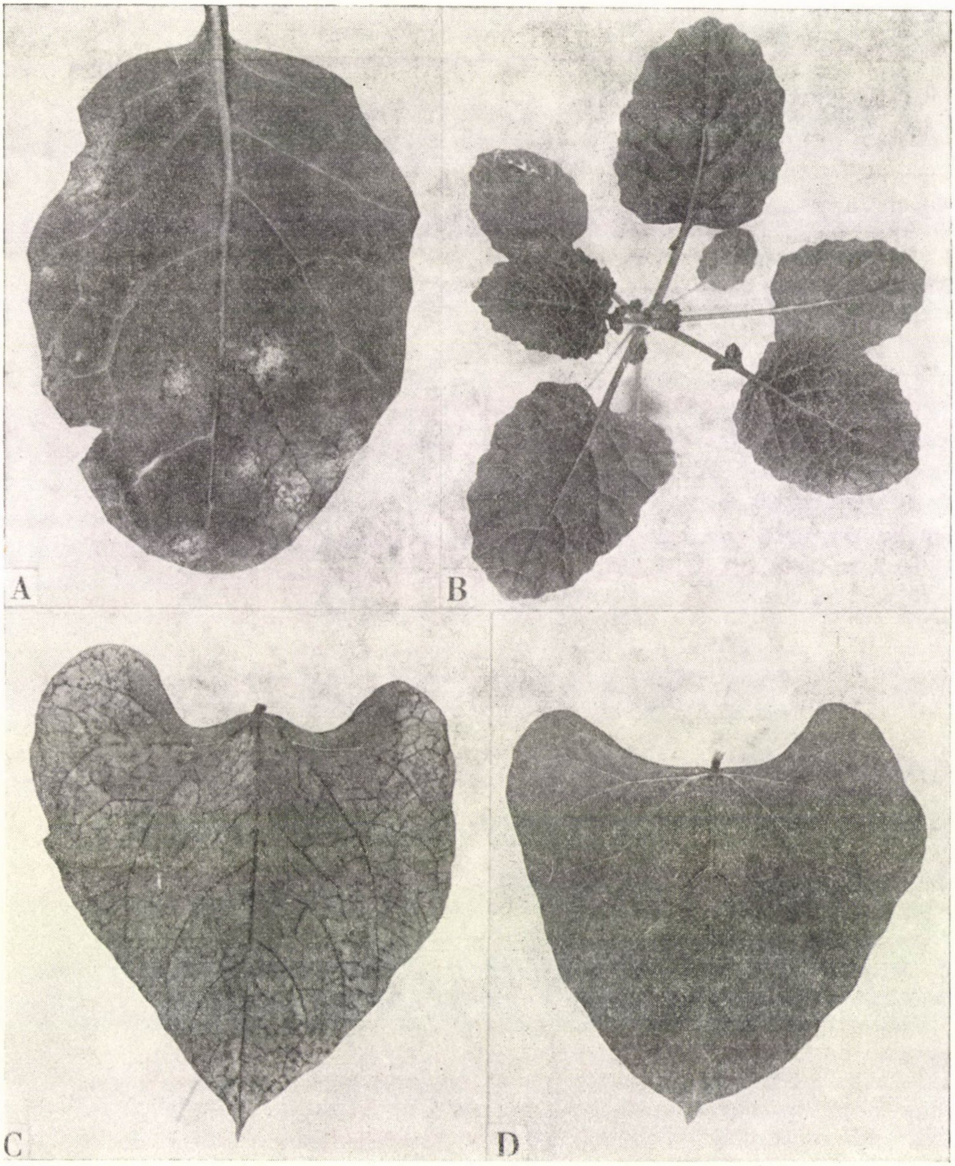

Fig. 1. A: Necrotic local lesions induced by tobacco necrosis virus on *Crambe abyssinica* Hochst. ex R. E. Frees, B: Comparable control plant of *Crambe*, C: Local lesions on *Phaseolus vulgaris* L. cv. *Fürj* infected with tobacco necrosis virus recovered from *Crambe* plants, D: Comparable uninoculated *Phaseolus vulgaris* L. cv. *Fürj* leaf

1954, obtained from M. Zaitlin in 1964) white strain of CMV (Schmelzer 1962, Skiebe—Schmelzer 1967), and strain R of CMV (Horváth 1968). The viruses were kept in *Nicotiana tabacum* L. cv. *Samsun* (PVX, PVY, TMV—Ul, CMV [white and R strains]), *Nicotiana gluti-*

nosa L. (PAMV) and *Phaseolus vulgaris* L. cv. *Fürj* (TNV), respectively. For mechanical inoculation leaves from infected plants were triturated with mortar and pestle. The extracted juice was diluted 1 : 2 with tap water and applied to the upper surface of the leaf with a glass spatula. Carborundum (500 mesh) was used as an abrasive. All leaves were rinsed immediately after inoculation and kept at approximately 20—24° C.

For the recovery of viruses *Lycium halimifolium* Mill. (PVY), *Gomphrena globosa* L. (PVX), *Capsicum annuum* L. (PAMV), *Phaseolus vulgaris* L. cv. *Fürj* (TNV), *Chenopodium amaranticolor* Coste et Reyn. (white and R strains of CMV) and *Nicotiana tabacum* L. cv. *Xanthi-nc* (TMV) were used. Before extracting the virus from them, the leaves were immersed in 2 per cent NaOH solution followed by through washing with running tap water.

The results have shown *Crambe abyssinica* to be susceptible to strain b of TNV and strain Ul of TMV, and not susceptible to PVX, PVY and PAMV, as well as to two CMV strains. *Crambe abyssinica* is a symptomless carrier of Ul strain of TMV. Strain b of TNV induced grey necrotic lesions of irregular shape on the inoculated leaves of *Crambe* plants and increased to about 3—5 mm in dimension after 5—7 days (Fig. 1). Virus was recovered from these lesions uninoculated leaves of infected plants remained symptomless and virus could not be recovered from them. *Crambe abyssinica* is an unsuitable host for the separation of CMV strains.

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Prepared at the Department of Plant Pathology, Research Institute for Plant Protection, Budapest.

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CONTRIBUTIONS TO THE SEED DEVELOPMENT OF FIELD POPPY

(*Papaver rhoeas* L.)

After our histogenetical investigations on *Papaver somniferum* L. (Gracza 1964, Sárkány—Gracza—Paál 1966, Gracza—Sárkány 1967) we have scheduled similar studies on other species of the genus. Within the scope of this program we have first examined *Papaver rhoeas* L. Since earlier works on *Papaver rhoeas* L. included the structure of the seed-coat (Röder 1958), the construction of the embryo sac (Schnarf 1926), the embryogenesis (Souèges 1936) and the effect of intraovarian pollination (Kanta-Maheshwary 1963), the present study deals with the seed development of this species and with the incorporation process of nutritive substances accumulated in the seed.

Fig. 1. Longitudinal section of young ovules (Magn. 250×)

The material used for the examinations included the fully developed ovary and capsules of different degrees of development, ranging from inflorescence to full ripeness. After fixation in Navashin solution, 10—12 μ sections were made with the usual microtechnical methods. Some of the sections were stained with Ehrlich's haematoxilin, while others were left unstained and were treated with iodine-iodide of potassium solution, Soudan III, Millon reagent and Nile blue.

The strongly incurved (camylotropic) ovules in the ovary of the open flower (Fig. 1) are covered with two integuments described by RÖDER (1958) as being composed of four layers. The present study has shown, however, that the external integument consists of two cell layers and the internal one of three cell layers. It is characteristic of the nucellus cells located inside the integuments that the large-sized nuclei are surrounded by small translucid corpuscles They get stained yellow by iodine-iodide of potassium, so they are of proteic consistence and may be considered amyloplasts. These amyloplast bodies may also be found in the cells of the placenta sheets.

In the female gametophyton surrounded by the nucellus we have found but 3 antipodes instead of the 5 observed by HUSS (1906) and SCHNARF (1926). So the female gametophyton may be considered a *Polygonum* type of only eight and not of ten nuclei.

Fig. 2. Longitudinal section of a developing ovule. Starch granules segregated in the amyloplasts present in the cells of the perisperm and the chalasal tissue. (Magn. 250×)

The day after inflorescence the female gametophyton vigorously increases at the expense of the nucellus tissues. The antipodes increase particularly in size, a phenomenon to be partly explained with endopolyploidy as described by HASITSCHKA (1956). The nucellus tissue becomes single-layered at the micropylar part and continues to have several cell layers at the chalazal pole only. As shown by the bluish-violet staining caused by potassium-iodide treatment, starch is segregated in the amyloplasts of its cells (Fig. 2). Large amounts of starch are also formed in the cells of the placenta sheets and of the fruit wall.

Meanwhile, some changes may be observed within the female gametophyton as well. After pollination the triploid endospermal zygota moves from the centre towards the strongly increased group of three antipodes and undergoes a manifold mitotic division. The newly formed nuclei are moving now along the periphery towards the micropyle and, with further division, create a single-layered nuclear tapetum. Due to the simultaneously formed cell walls a cellular tapetum is formed within a short time. At the same time the embryonal zygota begins to divide.

Division becomes accelerated in the cellular tapetum and the more or less radial cell rows running in a centripetal sense create a dense endosperm tissue. The endosperm puts a pressure on the remaining nucellus tissue, which becomes always smaller at the chalasal part, while the starch is disappearing from the cells.

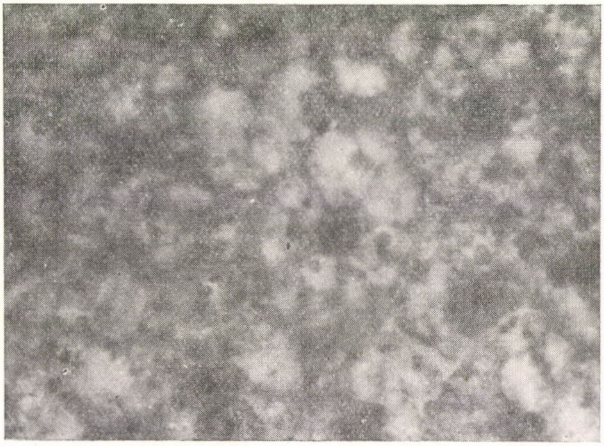

Fig. 3. Endosperm fragment at the beginning of stabilization. Aleuron appearing around the nuclei and located in the vacuoles. (Magn. 800×)

Simultaneously with the functioning of the endospermal zygota a yellow colouring agent is segregated in the cell row of the seed-coat adjacent with the nucleus, the seed-coat being differentiated from the integuments; a distinct stabilization process is starting in the other cell rows too.

By means of subsequent divisions the embryonic zygota creates at the same time a pro-embryo of spherical stage which grows into the endosperm tissue while continuing to differentiate and to increase. Containing small starch granules for a short while, amyloplasts are appearing at first in the endosperm cells. The stabilization of the endosperm cells continues, while small vacuoles are formed in the cytoplasm, with a proteic substance being segregated (Fig. 3). The small vacuoles get fused and the condensation of the proteic substances produces a heterogeneous aleuron. The transitory starch gets gradually consumed, a steadily increasing

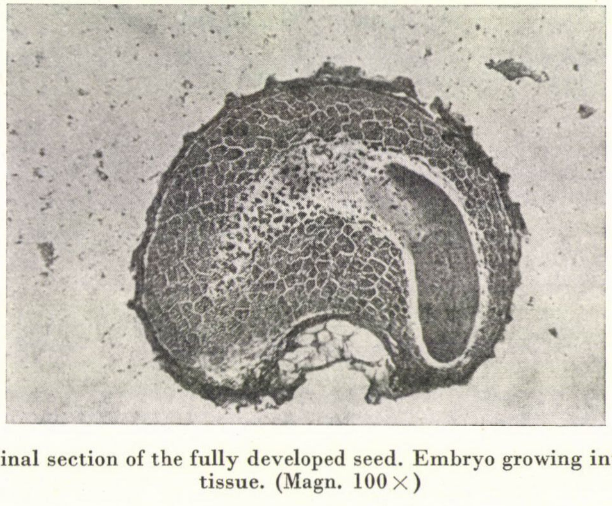

Fig. 4. Longitudinal section of the fully developed seed. Embryo growing into the endosperm tissue. (Magn. 100×)

amount of fatty oil appears in the plasma which is indicated by the red staining produced by Soudan III treatment.

As a second step, desorganization processes are beginning in the central part of the endosperm tissue filled up with stored nutrients (heterogeneous aleuron, fatty oil), because the further increase of the embryo (torpedo, elongated torpedo) takes place at the expense of the existing endosperm tissue (Fig. 4). The cell row of the endosperm tissue adjacent with the embryo gets evacuated and its content is probably utilized for the development of the embryo.

As shown by the investigations, the formation and accumulation of nutrients during the seed development of *Papaver rhoeas* L. are taking place in four phases: 1. accumulation of starch in the nucellus, 2. accumulation of starch in the young endosperm, 3. accumulation of heterogeneous aleuron in the vacuolized endosperm cells, 4. appearance of small drops of fatty oil, representing the bulk of the stored nutrients.

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VARIABILITY — CORRELATIONS — PREDICTION

(A theoretical model)

1. The method of predicting the qualitative characteristics is applied with quite a series of cultivated plants in order to promote the proper breeding schedule. This was the reason why experiments were conducted as to the possibilities of acquiring early information about the range of performance. The investigations were carried out on allogamic sugar beet. As yield and sugar content are, and have always been considered the decisive criteria of value, it has been examined, since 1962, to what extent is foretelling reliable in estimating the crop prospects. These investigations of individual plants through 5 years, aiming mainly at the determination and reckoning of yield as well as at morphological marks, have led to the setting up of a theoretical model which is going to be expounded in the following. In order to avoid any misunderstanding it is to be pointed out that this survey of the variability components, correlation coefficients, and effectiveness of early selection, is not more than an attempt of explanation.

2. In the Figure the idealized curves 1.1 to 1.4 represent different existing variants of the total annual variability being made up by genotypic and environmental components and indicated by variability coefficients. In the case of the approximately 100 trends, according to the results of both the non-destructive glass-house and field experiments, it is the thickened curve 1.1 which shows the most frequently occurring annual total variability. This curve declining regressively from the beginning of the vegetative period up to mid-July, then slowly rising again, serves as the main basis of later considerations. Relying on the diverse characteristics of the four curves 1.1—1.4 and on the specific traits of each trend, it can be concluded that this type of curves is of genetical origin only to a relatively small degree. This finding agrees with the fact that the heritability of the yield components in sugar beet is relatively low in both glass-house and field experiments. In addition, on the basis of literary information, respective results and experiences, and theoretical considerations we have come to realize, in estimating the qualitative characteristics and sugar content, that in the individual plants of a genetically limited population, i.e. "families" the proportion of the genotypical variability to the environmental one is 1 : 9 under the usual sowing conditions prevailing in Central Europe (see the relative numbers submitted by Powers). Accordingly, mean level of the curves 1.1—1.4 can be traced back, in about 90 per cent, to changes caused by seasonally changing inhomogeneities of soil, sowing-technique, plant pests, competition, weather, laboratory analyses and other factors; besides, it must be noted that plant mass is generally considered a character with higher variability than sugar content. Thus, the variability coefficients, when supposing identical, or highly similar genetical dispersion, have the same probative force as of experiments

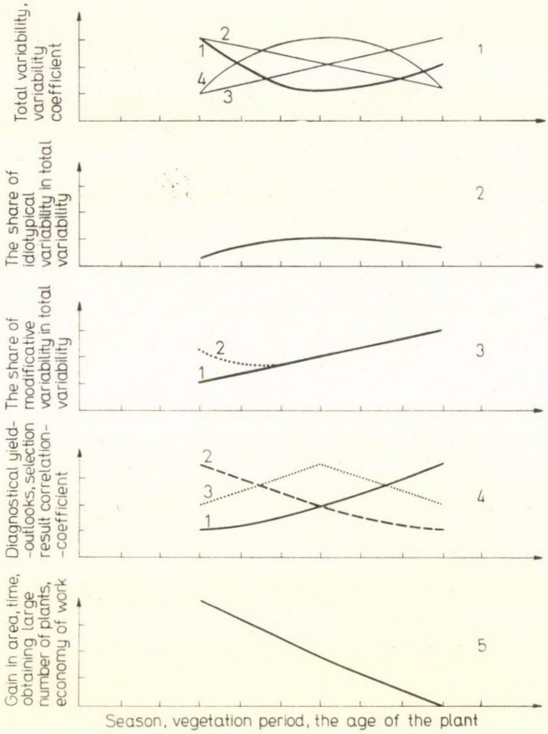

Fig. 1. Variability, correlations, prediction

conducted in the field. Here must be mentioned the reasoning of some practical experts who, contrary to the principles accepted as basis in this paper, plead exactly the examination to be conducted under practical conditions, as they held that the genotypes appearing under heterogeneous conditions are different from those showing up in homogenous environment.

3. Extensive homogenization of the determinant environmental factors can be realized only by switching over to an expensive hydroponic system. When comparing hydroponics with soil one may encounter a new uncertainty factor arising from among these problems, and — nevertheless — the principle of ceasing environmental unbalance by replications and large number of plants, cannot be utilized due to the non-recurring existance of each plant; the separation of the genotypical variability from the environmental one would cause considerable difficulties, unless one follows the weary and time-consuming pattern of examining heredity. Presuming that the relatively small degree of genetical variability remains approximately the same throughout the whole vegetative period, curve 2 can thus be deduced from curve 1.1 only. Therefore it is proved by cogent logic that the genotypic variability within the total variability has a seasonal tendency increasing regressively up to mid-July, and, towards the end of the vegetative period it decreases progressively to about half of the maximum value. When, in utter negligence of any other criterion, crop prospects acquired by prediction are judged mainly by rating of genetical variability prior to the synoptical examination of the trends 1.1 and 2, the best selection possibilities are obtained for mid-July, when the stock concludes changing, and when the maximum uniformity of the plant material corresponds to the largest genotypical differentiation within the total variability. In this connection, according to **Hiorth**'s points, the possibility may become important that the absolute level of genetical variability can be raised by passing over from optimum ecological conditions to less favourable ones, thereby it would be rendered easier in the extensively homogenized environment to find the + and — variants being looked for.

4. Curve 3.1 shows the rate of the environmental variability within the total variability in the course of the year, giving a graphical representation of the hypotheses drawn up by authors, who, taking an opposite standpoint to the concept outlined in Chapter 3, consider the chances of selection as most promising at an early developmental stage, as then the plants are not yet exposed to those environmental inhomogeneities which have an increasingly modifying effect in the course of the year. These conceptions seemingly disregard the arguments stating that the genetical interactions are not yet effective at an early phase. Later, we shall refer to this in detail. Curve 3.1 as modified by variant 3.2 being expected in the case of very uneven emergence, shows a rising trend throughout, which corresponds to curve 2 only in the second half of the vegetative period, while taking into consideration the variant 3.2, also in the first quarter of the growing season. Further theoretical analyses shall be based mainly upon the variant 3.1.

5. Curves 4.1—4.3 demonstrate rank correlation coefficients which were determined in between the early and mature stages of a single plant with the aid of mostly morphological characteristics. They may serve as standards for the estimation accuracy of the prediction and for the chances of selection. The basis of the three variants consists of several hundred trends obtained through non-destructive testing techniques in experiments; of course, all modifications are included in their number. Curve 4.1 was constructed by counting the measurement and estimation values of a population, obtained in 14-day-intervals, as opposed to the corresponding values of an identical material, up to the date of harvest. Thus, the coefficients counted for the different developmental stages represent a standard of the current agreement with the final values. Curve 4.2 demonstrates a variant whose general correlational basic value is that of the young plant; viz. all values counted separately at each developmental stage were matched to the corresponding data of the population in question. Variant 4.3 results if all data are matched to the corresponding data of an intermediate developmental stage. Precondition for

the evaluation method of 4.1—4.3 is that morphological characteristics and sugar content should be determinable at the two, or four-leave stage; in the case of sugar beet this can be performed methodically. Sense of the general relationship is that from it arise the different compensation possibilities between the genetical interactions and the corresponding rate of the genotypical variability (curves 2 and that deduced from 3.1 respectively). The rise of the trends 4.1—4.3 displays a measure for the extent of environmental influences. In an environment being assumed as absolutely uniform and containing only the phenotypes that induce exclusively the appearance of the genotypical variability, the outlined trends would only show very slight rise that could be traced back to the effect of genetical interactions. So the values denoting the crop prospects and being actually acquired by prediction always increase when approaching the evaluation basis considered alternatively the most favourable; this can also be traced back to the continuous development of the mass and sugar content during the whole vegetative period. The correlation coefficients, however, similarly to the variability coefficients (curves 1.1—1.4) are mostly of environmental origin. For further views the variant 4.1 may serve as basis.

6. Finally, curve 5 is to symbolize the economic effects of an early selection, making it tangible in the form of saving area and time as well as showing the advantage of a great number of selections, or the efficiency of work. Thus, the curve is to show a continuous decrease from germination to maturity, or, in another term: early selection seems to be most efficient at the stage of germination, i.e. at the beginning of the vegetative period.

7. This model described and graphically demonstrated above aims primarily at measuring the criteria for the chances of an early selection, with the assumption of alternate developmental stages and different vegetative periods. Thus, in making prediction with young plants being at the beginning of the vegetative period when the stand is highly uneven (curve 1.1) one may observe that the high total variability corresponds to little genetical variability (curve 2), relatively low correlation coefficients and poor crop prospects in the selection (curve 4.1), while it may be advantageous as it results in saving area and time and makes work economical with a large number of plants (curve 5). Thus, vertical synopsis of the five-part diagrams gives a survey of the crop prospects of an early selection carried out at various developmental stages and on different dates of the vegetative period. Here it is to be pointed out that for the sake of a clear view we did not insert in the model described a curve demonstrating the effects of genetical interactions. If these effects had been demonstrated in percentage of the final evolution of the phenotype, their annual course would have approached curve 3.1; implying that the phenotypical resemblance of the individual plants, if it is of genetic origin, would continuously increase. This requires, however, that the parameters of the mature plant should be chosen as a general basis of reference. As to the relationship of the genetical interactions, the reference points of the curves 4.1—4.3 and their trends sufficient information was given already in Chapter 5. For the sake of a clear synopsis the demonstration of a yield-curve had also to be omitted; its S-form is presumably well-known, anyway.

8. In order to acquire information by prediction about the crop prospects of sugar beet a theoretical model was graphically elaborated whose basis was made up by a series of investigations conducted over 5 years and aimed at the qualitative characteristics of the individual sugar beet plants. The variability components and the profit rate of early selection are explained through diagrams. By means of a vertical synopsis the graphical model facilitates the estimation of the specific criteria, as based on all the developmental stages of a population.

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ANISOTROPIC STAINING OF THE CELLULOSE CELL-WALL

A high degree of molecular orientation is characteristic of the ultrastructure of cellulose, the molecular chains of which in the cell wall are arranged parallel with one another forming often crystalline structured micelles. Polarization optics has been useful in studying the micellar texture of cellule also when applied to native unstained specimens. However, the effectiveness of the polarization optical analysis can be greatly enhanced by topo-optical reactions which are induced by orientated binding of molecules of colourless compounds or of dye staffs on subject with micellar ultrastructure. Only objects with regularly ordered ultrastructure are capable of giving such topo-optical reactions which manifest themselves either in the increase of the original birefringence of the micellar texture without any change in the optical character or in an inversion of the original birefringence. Romhányi (1962) distinguished two types of the topo-optical reactions induced by orientated association of appropriate molecules on micellar textures: 1. the additive type, characterized by an increase in the original birefringence of the micellar texture without change in the original optical character of the (unstained) structure, and 2. the inversive type, characterized by an inversion of the optical character of the micellar texture. Since topo-optical staining reactions can only take place on substrates with micellar textures, the observation of such reactions on biological substances is indicative of the presence of an ordered ultrastructure, even if this could not be detected by the polarization optical observation of the unstained specimens or by electronmicroscopy. Topo-optical staining reactions are able to provide useful information on ultrastructural characteristics of micellar textures. For instance an inversion of the additive type of the staining reaction of a substrate into an inversive type can disclose ultrastructure and changes in the micellar texture not to be recognized in electronmicroscopy. Such a change in the staining reaction of a substrate is the result of an alteration in the orientation of the dye-molecules from axiparallel into axiperpendicular due to molecular ultrastructural changes of the micellar texture induced by experimental procedures, or pathological conditions. The anisotropy effect of the topo-optical staining reactions can be quantitated by establishing the anisotropy index (AI) of the reaction as introduced by Romhányi (1962, 1966). The anisotropy index of the reaction is of special value for the registration of quantitative and qualitative differences in the orientated dye-binding capacity of micellar textures as observed under induced different experimental conditions.

The anisotropy index AI is expressed as $AI = \frac{b}{a}$ where a = the original anisotropy of the unstained substrate expressed in mμ-s of retardation, and b = in the total anisotropy (in mμ) induced by the staining reaction on the substrate (b is calculated: in the case of an additive type of topo-optical reaction as $x - a = b$ where x = the total anisotropy (in mμ) of the stained substrate; and in the case of an inversive type of stainig reactions as $x + a = b$). The intensity of the birefringence induced by the orientated binding of dye-molecules with selective absorption is dependent on the wave-length of the light used (as the result of the anomalous dispersions of the refraction indices). The value of AI therefore varies according to the different wave-lengths of light. For standard results, measurements are to be made at constant wave-lengths for a given dyestoff.

In the following we will report on our polarization optical studies of topo-optical staining reactions carried out on the outer lamellae of the wall of the axial cells of *Chara hispida* L. which show a micellar texture with a fibrillary structure transversal to the long axis of the cells. Several anionic and cationic dyes were used. The following anionic dyes were found to induce changes in the anisotropy due to orientated binding of the dye molecules on the micellar texture of the lamellae: Congo red, Congo corinth, Benzoazurine, Benzopurpurine, Trypanblue, Trypanred (all diazodyes of the benzidine type) and the following cationic dyes were found to cause anisotropic staining of the lamellae: Rivanol, Coriphosphin (Acridine dyes), Neutral red, Safranin (Azinedyes) Cresylblue, Cresylviolet, Nileblue (Oxazinedyes), Toluidine blue, Thionine, Azur A and Methylene blue (Thiazinedyes). The anionic dyes were used at concentrations of 0.2—0.5 per cent. The specimens were stained for 10 minutes. In the case of the acridine and thiazine dyes a post-staining treatment with potassium ferricyanide (2 per cent) or a mixture of aqueous potassium ferricyanide (2 per cent) and potassium jodid (2 per cent) (1 : 8) was applied which stabilized the dye molecules bound on the structure and, at the same time, increased markedly the anisotropic effect of the staining reactions (Romhányi 1962, 1966). After treatment with the precipitants the specimens were included in Gum. arabic containing the precipitant used, in a concentration of 0.2 per cent. After drying of the gum. arabic layer the visual and optical effects of the topo-optical staining reactions remained for unlimited time. Specimens stained with the anionic dyes were included in Gum. arabic or after dehydration in Canada balsam. Measurements were made on the (unstained and the stained specimens) in most cases successively on the same specimen. The values of the retardations were measured at different wave-lengths through the whole visible spectrum using a Zeiss interference filter. Thus the curve of the dispersion of the birefringence of the stained lamelle as a function of the wave length was obtained. The anisotropy index of the staining reaction for a given dye was calculated on the basis of retardation measured at wave-lengths with the highest values of retardations on the long wave side of the absorption band of the dye. The polarization optical investigations were made on a Leitz Ortholux polarization microscope, equipped with rotating compensators (16 and 57 mμ). Of the factors influencing the anisotropic staining reaction as a result of changes in the micellar texture, the effect of cellulose I was transformed into cellulose II by mercerization in 20 per cent KOH at 80—90° C for 10—20 minutes. Sulfuration was carried out on completely dehydrated specimens by treatment with a mixture of conc. sulfuric acid and ether sulfuric (1 : 3) for 1 minute followed by eluation of the sulfuric acid by alk. abs. and then taken through diluted alkohol into water.

Anisotropic staining reaction with direct cotton dyes. Direct cotton dyes are anionic dyes, with elongated coplanar molecules, which are able to arrange themselves in an orientated pattern on the micellar surface of cellulose, as indicated by the positive dichroism (Schmidt 1932, 1938*), and by the strong increase in birefringence of the unstained cellulose without change in the optical character.

The dispersion curve of birefringence (Fig. 1) and the positive dichroism striations indicated that the anisotropic staining reactions were of the additive type and that the dye molecules were arranged axiparallel with their light absorbing bands (corresponding to the length of the dye molecules) to the fibrillary pattern of cellulose thus the dye molecules of the cotton dye type are arranged parallel on the micellar surface of the framework of cellulose giving rise to a marked increase in birefringence of the lamellae.

Table 1 shows the values of the anisotropy indices obtained with different dyes, calculated from the maximum values of the retardations, measured at the wave-lengths indicated in Table 1. It is remarkable that, though the direct cotton dyes used in our experiments were structurally closely related, their capacity to increase the birefringence in the stained specimens was very different, as seen in the differences of anisotropy indices of the different dyes. In the course of our investigations we have tested also a number of other direct cotton dyes (Solantin red, Chrysophenin G, Sirius supra türkis) of coplanar molecule forms which, however, differ from the disazo-dyes of benzidine type by being usually more complicated than those. The anisotropic staining effect of these dyes was found very weak. This is most probably due

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* The explanation about the positive dichroism of Congo red staining is known through the works of W. J. Schmidt, however, Schmidt has examined the dichroism of stained fibers only, and has not studied the phenomena of birefringence.

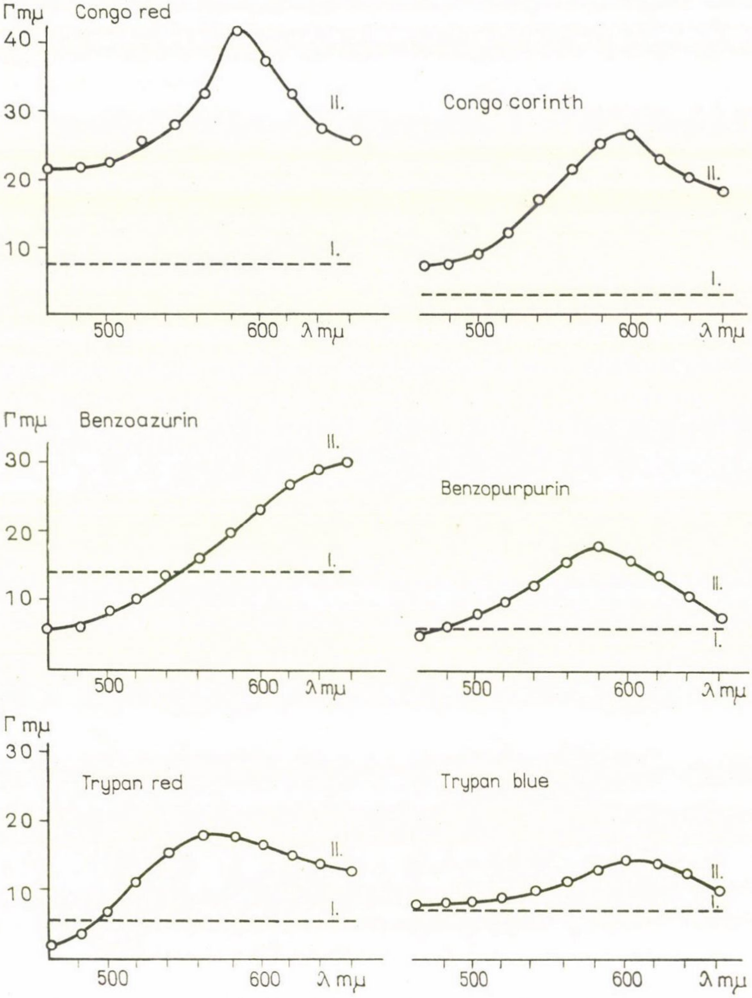

Fig. 1. **Retardation of unstained (I) cellulose cell-wall lamella and of that stained with direct cotton dyes (II) as a function of the wave-length**

Table 1

The anisotropic staining effect of the direct cotton dyes

Dye	anisotropy index	wave-length mμ
Congo red	+8	580—600
Congo corinth	+8	580—600
Benzoazurine	+1.6	620—660
Benzopurpurine	+2	580—600
Trypanblue	+0.5	600—620
Trypanred	+2	580—600

to the great number of side groups that inhibited sterically the dye molecules to be bound in an orientated pattern on the micellar texture.

The data in Table 1 show that the higher increase in birefringence was obtained by staining with the red direct cotton dyes, of which the Congo derivatives were the most effective, the higher values of anisotropy are obtained at wave-lengths indicated in Table 1.

Anisotropic staining with cationic dyes. We have found that several cationic dyes of azine, acridine, oxazine and thiazine types were able to produce strong (inversive) anisotropic staining reaction of the cellulose. The polarization optical pictures in Fig. 2 demonstrate the inversive type of the anisotropic staining reaction of cellulose as induced by toluidine blue.

The optical analysis of the dispersion curve of birefringence (Fig. 3) and the negative dichroism with maximum absorption for light polarized perpendicular to the micellar fibrillary texture, indicate that the dye molecules are orientated with their light-absorbing bonds perpendicularly with respect to the micellar texture. The inversion of the original birefringence for light of the long wave side of the spectrum can be seen in the curve of the dispersion of the birefringence (Fig. 3).

Table 2

Anisotropic staining effect of cationic dyes

Dye	anisotropy index	wave-length mμ
Rivanol	—3	460
Coriphosphine	—0.4	460
Nileblue	—3, —5	580—600
Cresylviolet	—4, —5	560—580
Cresylblue	—5, —6	580—600
Safranine	—3, —4	500—520
Neutral red	—5,	560—580
Toluidine blue	—5, —10	560
Methylene blue	—4, —6	600
Thionine	—3, —4	510—530
Azur A	—3, —4	560—580

The high values of anisotropy indexes of the staining reaction by several dyes, listed in Table 2 show that the orientation of the acridine-, azine-, oxazine- and thiazinedyes is, in general, of high degree. The anomalous dispersion curve of the birefringence of lamellae stained with different cationic dyes was typical with a sharp inversion of the optical sign of the birefringence in the region of the absorption band of the dye used. It can be seen that in the case of the metachromatic dyes (toluidine blue and azur) the inflection of the dispersion curve dissects the line of isotropy at about 540—560 mμ, that is in the region of the metachromatic absorption band, which is characteristic for a micellar aggregation of these dye molecules. The anisotropy induced by the staining reactions is, in the case of azine-, oxazine-, thiazinedyes, especially strong. The greatest effect was induced by Toluidine blue, Cresylblue and Cresylviolet.

The anisotropic staining reaction of cellulose with altered micellar structure. Anisotropic staining reactions are the results of the orientated binding of dye molecules on micellar texture.

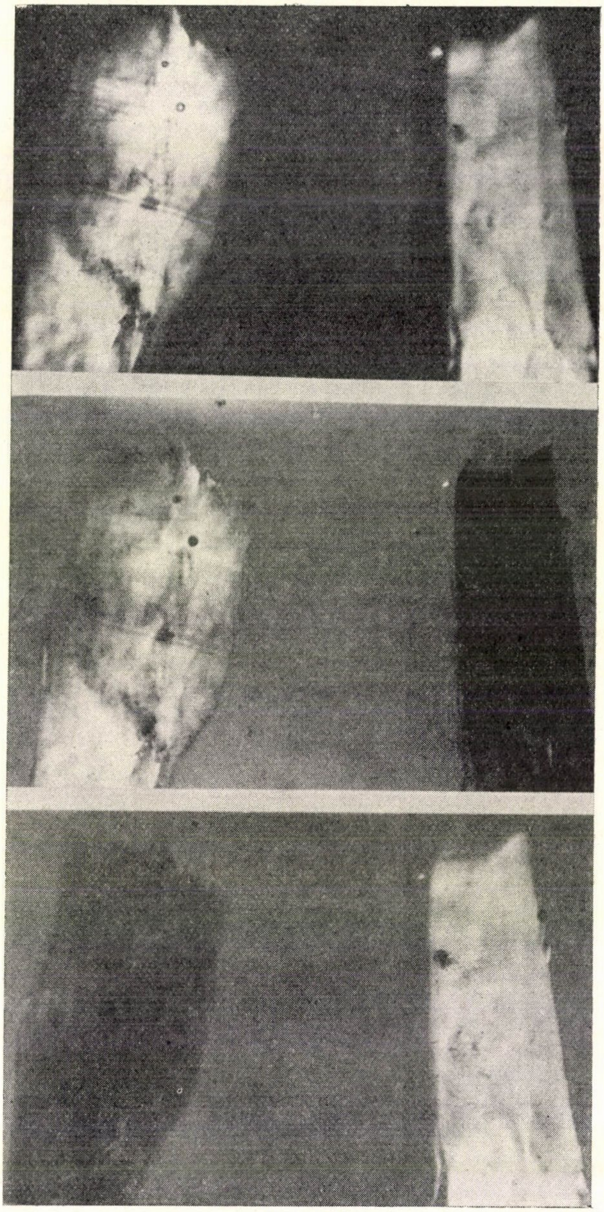

Fig. 2. Unstained (left) cellulose lamella and that (right) stained with toluidine blue in diagonal position between crossed polaroids; *b)* and *c)* the same preparate in the same position applying compensation of opposite direction. It is well visible that staining with toluidine blue has changed the optical character (About 100×)

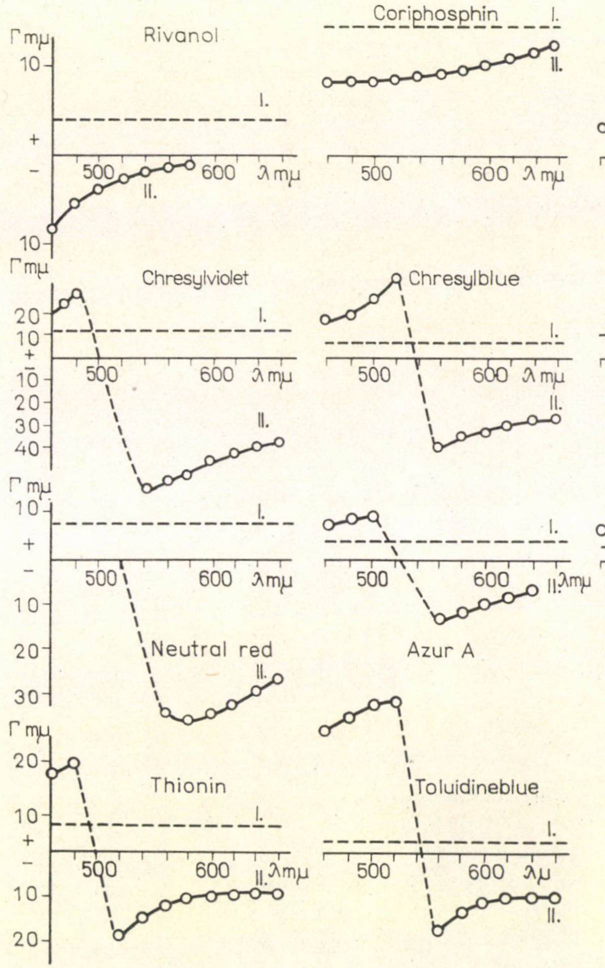

Fig. 3. **Retardation of unstained cellulose cell-wall (I) and of that stained with cationic dyes (II) taken as a function of wave-length.**

The molecular structure of the dye molecules and of the micellar texture are equally important for the development of such topooptical reactions. It seemed, therefore, possible that changes in ultrastructure of the micellar texture can be reflected by changes in the topooptical staining reactivity of the structure. In studies of the anisotropic staining reactions of collagen it was found, that the additive anisotropic staining reaction of collagen by toluidine blue turned into an inversive type of anisotropic staining reaction as a result of changes in the micellar structure of collagen induced by swelling or by heat (Romhányi, 1966). In view of these findings we have studied whether ultrastructural changes in the micellar texture induced by mercerization and sulfuration cause a qualitative or quantitative change in the anisotropic staining reactivity of the cellulose.

We have found that mercerization which induces a transformation of cellulose I into cellulose II, or hydrat cellulose, resulted in a change in the type of the anisotropic staining reaction with toluidine blue. The inversive staining reaction of cellulose I turned into an additive staining reaction of cellulose II (Fig. 4). This phenomenon seems remarkable in view of the fact that there is only minimum structural difference between the two types of cellulose; cellulose II is more hydrated and contains more crystall water, however, no change in the spacing of the unit cell occured indicating that the elementary crystall structure had not been altered. Sulfuration, on which —OH groups of the cellulose become sulfated, does not cause qualitative change in the anisotropic staining reaction. The staining reaction remains of inversive type.

In summarizing our findings it can be stated that the cellulosic micellar texture of *Chara hispida* L. is able to bind in an orientated pattern the molecules of both the anionic and cationic dyes. The topo-optical staining reactions as induced by the orientated binding can be studied properly in their quantitative and qualitative aspects by polarization microscopy.

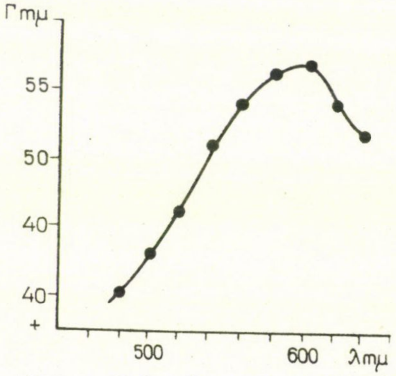

Fig. 4. Retardation of the cellulose II lamella stained with toluidine blue as a function of wave-length

Two types of topo-optical staining reactions of the cellulosic framework were observed:

1. Anionic dyes induced an additive anisotropic staining reaction. The greatest anisotropy effect (index) of the staining reaction was caused by Congo red and Congo corinth. The optical analysis in these cases indicated an axiparallel arrangement of the dye-molecules on the micellar framework.

2. A group of cationic dyes produced an inversive anisotropic staining reaction in which the optical analysis pointed to a perpendicular orientation of the dye molecules with respect to the micellar framework of the micellar texture of cellulose. The most intensive anisotropy effect in this group of dyes was produced by toluidine blue.

Topo-optical staining reactions appeared to provide a useful means for studying the ultrasturcture of cellulosic textures, in terms of their capacity to bind dye molecules in an orientated pattern and to indicate quantitative and qualitative differences of these reactions. The question why anionic and cationic dyes produced different types of the topo-optical staining reactions with differing orientation of their molecules with respect to the micellar texture of cellulose remains a subject for further studies.

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INHERITANCE OF COMPOUND TRAITS AND THE CONTRIBUTION OF SUB-TRAITS TO PRODUCTIVITY IN CULTIVATED PLANTS

Any empirically measurable trait of a phenotype or of related phenotypes may be considered to be compound in different senses. The phenotype is — as a commonplace — the effect of the interaction between genotype and environment. On the other hand any trait as a phenotypic unit may be analysed on the phenotypic level as a compound of sub-units, e.g. the yield of tomato is the product of the number of ripe fruits and the mean weight of the individual fruits; similarly the period between germination and ripening of the first fruit comprises the period from germination to the start of flowering and the subsequent period lasting until ripening of the first fruit. In the former complex the components interact multiplicatively whereas in the latter simply additively. It is possible to continue with subdivision of the components: the number of ripe fruits may be considered as a product of the total number of developed flowers and the ratio of flowers which set and their pistils grew ripe fruits; as well as the period from the start of flowering to ripening of the first fruit is the sum of two subperiods divided by the moment of the setting of the first fruit.

Analysis of a trait in this way may have its justification if the phenotypic components themselves are of economic interest, e.g. the mean weight of fruits; moreover knowing how the components will perform in a cross, may serve at the first sight as an important basis of understanding the structure of yield.

Productivity of an onion population, for instance, may be considered as a product of the weight of bulbs and the ratio of surviving plants. The variance analysis of the complex trait and its components including the Student's or Duncan's tests are shown on Table 1.

It is evident that the effect of hybrid vigour is not limited to any phenotypic trait, though expressed differently. Highest degree of superiority of F_1 combinations, however, was in the yield per unit area or per initial number of plants.

According to an appropriate experimental design the compound and each of the component phenotypic traits may be analysed in terms of genotypic and environmental effects in order to estimate the genetic values. A model derived from a simple block design may be: $X_{ijk} = m + h_i + r_j + hr_{ij} + e_{ijk}$, where X_{ijk} is the phenotypic value of an individual plant; m is the mean of the whole experiment, or the value common for all units; h_i characterizes the $i-th$ variety or genotype, r_j the $j-th$ block, hr_{ij} the $i-th$ variety and $j-th$ block as an interaction of the first order; finally e_{ijk} is anything which is unique for the $ijk-th$ element (individual plant). The ratio of the genotypic and the phenotypic variance in the whole experiment expresses the heritability in the broad sense of the measure in question:

$$V_G/V_P = \frac{s_h^2}{s_h^2 + s_r^2 + s_{hr}^2 + s_e^2}$$

Table 1

Effect of inbreeding and crossing on the productivity of onion populations 1965

Varieties Z = Zittauer, M = Makói

Yield			Survival			Mean weight		
Entry	kg/ plot	P=5%	Entry	D*	P=5%	Entry	gram	P=5%
Z×M F_1	3.4	●	Z×M F_1	28	●	Z×Z F_1	78	●
Z×Z F_1	3.3	●	Z×Z F_1	37		Z×M F_1	77	
Z×Z F_2 sib	2.9	●	M open poll.	45	● ●	Z open poll.	75	
M open poll.	2.8	●	Z×Z F_2 sib	67	● ●	Z×Z F_2 sib	71	●
Z open poll.	2.4	●	Z I_1	81		M open poll.	63	●
Z I_1	2.2	●	M I_1	84	●	Z I_1	56	●
M I_1	1.9	●	Z open poll.	110	●	M I_1	49	●

* D = 100×log (No. of dead plants per plot +1)

Further subdivision of the genotypic variance component s_h^2 may be effected by different methods. In a diallel system of intercrossing a set of eleven practically homozygous tomato varieties, as referred to in Table 2, let us take one of the simplest models of the general and specific combining abilities (g.c.a. et s.c.a.), which represent within the system studied one fourth of the additive as well as the non-additive effects, including some interactions, respectively (as for methodical details see Griffing 1956). Two complexes of phenotypic traits were studied. Those are (Yield = number of fruits. Mean weight of fruits) and (Earliness = time from planting to first flowering + time of first flowering to first fruit ripening). Phenotypic traits and variance components of the phenotype and genotype have been analysed simultaneously, as well as the simple phenotypic and genotypic correlations calculated. It is remarkable, that in the first system of phenotypic traits, where components interact in the expression of the compound trait (yield) multiplicatively, relatively high V_G/V_P values of the formers result in a low V_G/V_P ratio of the latter. Logarithmic transformation of the initial measurements applied here by several reasons did not alter this basic conclusion.

In the yield a low V_G/V_P ratio and a high variance component of replications represented the influence of the environmental effect. These are less true in the case of component Number of fruits and even less in the Mean weight of fruits. Highly negative phenotypic and genotypic correlations characterize the mutual relation of the yield components. None of these statements can be verified in the system of Earliness, moreover in certain respects the reverse may be true.

Variances of general and specific combining abilities revealed, that in the yield nonadditive inheritance was much more important in relation to the additive component of genetic variance, than in any other trait, particularly in the sub-traits of yield.

Those engaged in the problem of inheritance of compound traits were puzzled by the phenomenon just outlined and risked alternative explanations. Richey (1942) used the term of Mock-dominance for the result of interaction between sub-traits as the way of expression of heterosis in maize. Similar studies in tomatoes have been performed by Powers (1944), Griffing (1953) and Williams (1959). Williams attempted to understand the genetic mechanism by distinguishing between genic and somatic levels. Gene action may be considered as realized directly in the expression of simple component traits, whereas an interaction of those simple

Table 2

Genetical structure of compound traits and their component subtraits of a diallel system of tomatoes in terms of variance components
1965

Trait		$V_P = 100$				$V_G = 100$	
		V_G	V_R	$V_{G \times R}$	V_E	g.c.a.	s.c.a.
		variance components					
Yield of fruits	Y	25	67	4	4	51	49
Number of fruits	N	45	54	1	0	97	3
Weight of fruits	W	88	12	0	0	99	1
Earliness	E	94	2	2	2	94	6
Vegetative Period	V	77	16	4	3	92	8
Generative Period	F	69	24	4	3	93	7

	NW	YN	YW	VF	EV	EF
Phenotypic correlations	— .620	.438	.204	.062	.716	.761
Genotypic correlations	— .946	.315	.010	.445	.919	.930

$Y = N \times W$ $\qquad$ $E = V + F$

Note: Values but the three lowest ones of coefficients of correlation are significant at the P = 1 per cent level.

traits on the somatic level results in the expression of the compound trait. Interaction of simple traits as multiplicative components contributing to the expression of a compound trait in barley was visualized by Grafius (1960, 1961) in a rectangular space diagram. This concept was developed to a more abstract vector system (Grafius 1963). If in a three dimensional space still easy to comprehend a parallelopipedon represents the compound trait, the three dimensions may be substituted by the measures of the multiplicatively interacting components. Thus simultaneous increase of the linear components results in changes of the third power in the compound trait i.e. in the volume of the parallelopipedon. In the more elaborate vectorial model of a compound trait the degree of determination by components as linear vectors may be expressed by the relative angles of the vectorial quantities. According to Grafius it is more rewarding to study the genetic properties of the simple components, than those of the compound trait, which might be considered as a "mental construct" the elements of which are more realistic entities.

The concept of an analysis of phenotypic sub-traits in order to learn about the genetics of the compound trait was vigorously rejected by Hayman (1960). According to him distinction between genic and somatic levels of expression is an arbitrary fiction without either theoretical or practical justification; thus analysis of yield components creates merely confusion. The choice of the scale of measurement e.g. arithmetic or logarithmic, however, may alter the terms of interpretation of the underlying genetic mechanism.

Several authors, who were interested in the performance of yield and analysed its components too, accentuate different aspects of their results. Variously tight but negative correlation between sub-traits and loose positive correlation between the compound trait and the individual sub-traits have been reported by HOEN—ANDREW (1963) and LENG (1963) in maize. Similar conclusions have been drawn from experiments with other plants (DUARTE—ADAMS 1963, FORD 1965, KRONSTAD—FOOTE 1964, WHITEHOUSE *et al.* 1959).

Data of extensive maize experiments indicate that gene effects responsible for superior expression of yield are most liable to seasonal and local alterations i.e. to environment whatever the supposed genetic mechanism might be (overdominance, epistasis or linkage disequilibrium) (Inter alii BAUMAN 1959, GAMBLE 1962, a, b, c, GARDNER—LONNQUIST 1959). As a rule hybrid vigour prevalent in yield does not find its adequate counterpart in the components, whereas gene effects involved in the expression of the latter are less subject to environmental changes.

MOLL *et al.* (1962) consider the analysis of components to be irrelevant to understanding genetics of the compound trait. Yield itself should be truer representant of productivity in general arising as an integrated product from primary gene effects, than any other subtrait of yield, just because of the negative correlation, i.e. compensatory changes in the latter. This contention seems to be supported also by the data of CARMER—JACOBS (1965) inasmuch yields of the best maize hybrids of the Eastern U.S. did not differ substantially from each other over several years and locations. It was interpreted as a proof of the fact, that the most developed hybrids approached the plateau of maximal biological productivity conditioned by the given environmental range. The intriguing question of sub-traits was reassumed and contributed to by ADAMS' (1967) new considerations based on experimental findings. Essentially the concept of developmental correlations referred to as developed by STEBBINS (1950) was applied in the case of beans grown in a traditional dense population where, as a rule, tight negative correlation is characteristic for the relation of components of the seed yield. This correlation, however, cannot be considered to be of genetical nature because there is no trace of it in widely spaced plants. By means of further experimental data and references to physiological literature Adams attempted to follow up the physiological mechanism of compensatory development of the yield components, which compete for a common limited nutrient supply.

Phenotypic traits may be described according to their developmental relations as more or less flexible or as stable, alternatively plastic or rigid (BRADSHAW 1965). This property is a moment of adaptation to the forces of evolution. Human selection inherited but tried to transform these conditions either purposely or unconsciously. The plant breeder, though aimed to stabilize the reproductive capacity of a crop grown for its seed or fruit, created, however, through his agricultural practice a new milieu which subsequently gave more chance to relatively plastic phenotypes, moreover certain genuinly highly stabilized traits — as the rather small size of the seed or fruit — should be made more flexible purposely. Nevertheless some of the ancient stability has been preserved in modern varieties not without any appreciable merit for mechanization of the harvest.

The agricultural environment especially its cenological aspects conditioned the evolution of highly productive cultivars. Evolutionary possibilities of this kind, however, still cannot be considered as exhausted. Maximal yield per unit area as an ultimate aim of breeding procedures cannot be achieved without concepts of an "ideotype" of the future plant (DONALD 1968). The closer dependence from phytotechnical measures the higher plasticity, i.e. capacity of yield may be expected, but on the other hand certain phenotypic traits like stiffer foliage, less ramificating vegetative system, more coordinate developmental phases, larger, possibly stable fruit size are prerequisite of a successful variety adapted to a definite elaborate technology.

Whatever the role of phenotypic sub-traits in the expression of the hybrid vigour of yield might be, analysis and design of traits other than yield itself, particularly of properties which determine commercial quality, adaptation to definite technologies, performance in a dense population, possibility in mechanization of cultivation, harvest, grading etc. cannot be

ignored as interrelated more or less flexible units, which react differently to environmental changes.

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THE USE OF HYDROGEN PEROXIDE FOR CLEARING LEAVES

The technique of clearing various plant organs, especially for anatomical studies of leaves, has been in use since long. By this method the cells of the epidermis and mesophyll become sufficiently transparent, and one can obtain an overall picture of the construction of the leaf: venation, laticifers, stomata, sclereids, crystals, etc.

Earlier, lactic acid was commonly employed for clearing fresh leaves. Subsequently; the use of a mixture of lactic acid, phenol and glycerine was suggested (Aumann's solution, mentioned in STRAIN 1934). QUICK—PATTY (1932) used sodium hydroxide and sodium hypochlorite, but only temporary mounts could be prepared. Such preparations did not retain the stain for long and turned yellow after some time. STRAIN (1934) obtained better results by employing nascent chlorine in alcohol, and the leaves could be left in the solution for several days without any harmful effects. The leaves were then warmed in a mixture of lactic acid, phenol and glycerine. This technique has been considerably improved upon by FOSTER (1949; *see also* ARNOTT 1959). He used sodium hydroxide and chloral hydrate and suggested that the procedure was especially suitable for clearing flower buds, mature flowers, individual floral organs, and for the demonstration of idioblastic sclereids in the leaves. The latest suggestion is that of RODIN—DAVIS (1967), who find that the protease, papain, is very helpful.

During the course of our investigations on the leaves of some dicotyledons, particularly members of the *Euphorbiaceae*, we obtained better results by adding hydrogen peroxide to chloral hydrate (Figs 1—5). The procedure is described below:

1. Fix fresh material in formalin-acetic-alcohol; dried leaves should be soaked in hot water for about half-an-hour.

2. Place the leaves in 5 per cent aqueous sodium hydroxide at 37—40 °C; change the fluid until all the pigments have been removed. For delicate materials a concentration of 2.5 per cent is desirable.

3. Rinse the leaves thoroughly in water to remove all the traces of the alkali (preferably test with a litmus paper).

4. Transfer to a mixture of saturated solution of chloral hydrate and hydrogen peroxide* (1 : 1). The duration varies from a couple of minutes to an hour, depending on the size, texture, and condition of specimen. Thick, coriaceous leaves, or those with numerous sclereids (Figs 1, 2) or laticifers, may be kept at 27 to 35 °C to hasten the reaction.

5. Transfer to water, employing 75 per cent, 50 per cent and 25 per cent chloral hydrate (without hydrogen peroxide).

6. Wash thoroughly with distilled water.

7. Dehydrate in the usual manner by passing through 50 per cent, 70 per cent, 90 per cent and absolute alcohol (5 minutes in each).

8. Stain the leaves with 1 per cent safranin in absolute alcohol-xylol mixture (1 : 1) for 5 to 15 minutes.

9. If necessary, destain with a mixture of absolute alcohol and xylol.

10. Transfer the material to pure xylol and after a few minutes mount in canada balsam or any other suitable resin such as Piccolyte.

The schedule outlined above can be employed for clearing fresh, fixed or dried leaves. The entire process can be conveniently carried out in petri dishes, and takes only 3 to 5 days.

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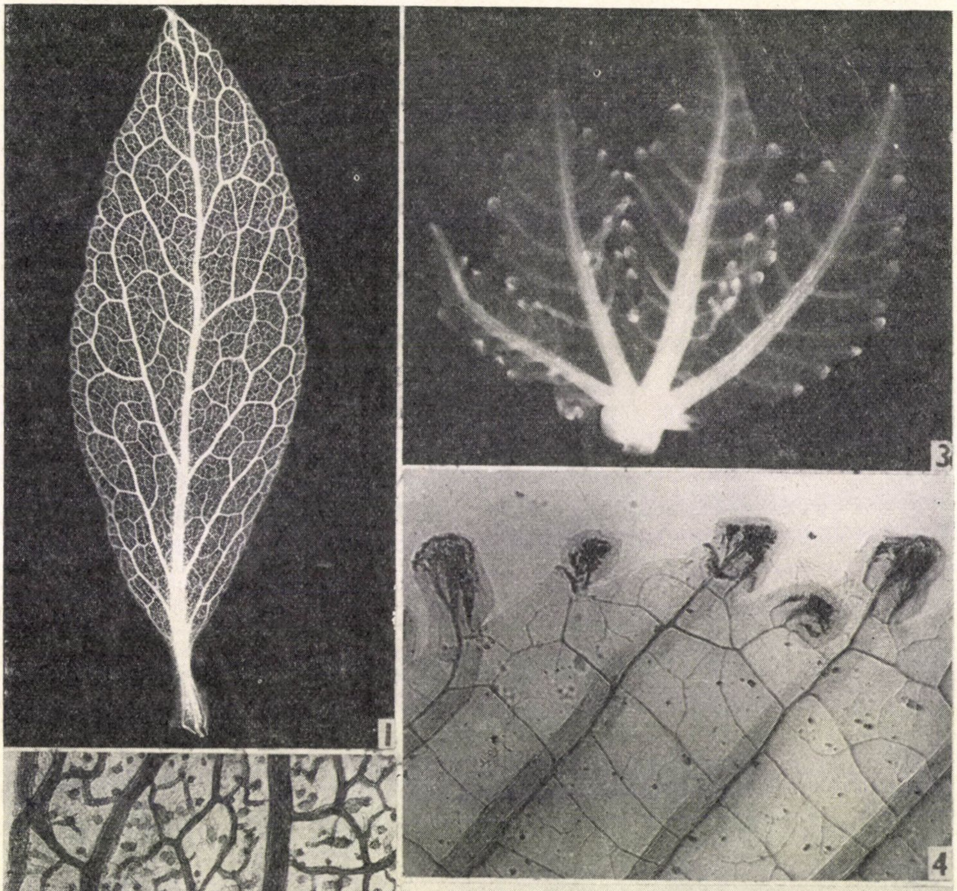
* We have employed 30 per cent W/V of H_2O_2 Supplied by BDH (LR grade).



Figs 1—5. Photomicrographs of leaves cleared by a mixture of chloral hydrate and hydrogen peroxide. *Fig. 1, 2. Garry veatchii* (from fixed material), whowing venation pattern and distribution of sclereids, Fig. 1× 7.5, Fig. 2×120. *Fig. 3. Ricinus communis* (from fresh leaf), note the glands, ×7.5. *Fig. 4.* Same, a portion enlarged to show accumulation of tracheids at the base of the glands, ×120. *Fig. 5. Euphorbia milii* (from herbarium specimen), a portion enlarged to exhibit the tracheids accumulated in areoles and near the margin. ×120.

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THE EFFECT OF ROOTING INHIBITORS ON THE CUTTING OF TRADESCANTIA ALBIFLORA

Tradescantia albiflora has been chosen as test plant for our experiment, as its stem cuttings form roots easily and well, and the leaves can be preserved in isolation for a long time. Within 3—4 weeks, a well rooted, uniform, intensively developed stand can be produced. The terminal and stem parts can be equally well utilized according to the polarity at the cutting of the plant.

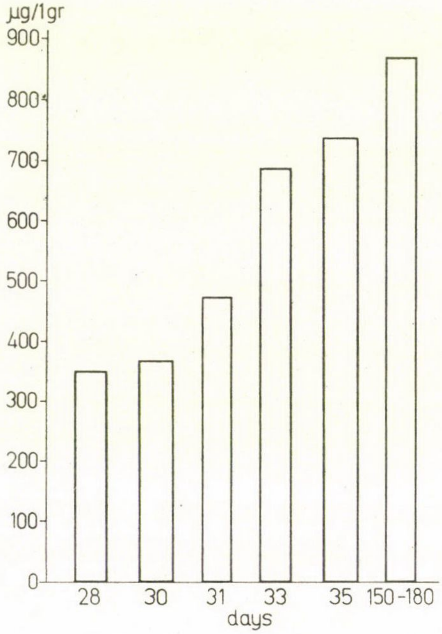

Fig. 1. The formation of total total phenol content in the rooted Tradescantia plant as a function of time. (Total phenol content in 1 g. fresh weight)

The long terminal shoots of three pairs of *Tradescantia* leaves, were put into 100 microgram/ml thiouracil and 0.1 per cent digitonin solutions; shoots put into ion free water and the rooted plants were used as controls. Such an amount of shoots had been placed into the ion free water that in the first four days, the shoots could be daily transferred into the thiouracil and digitonin solutions as to observe the rooting being inhibitable i.e. the effect of the treatments.

The same experiment was carried out on stem parts being three pairs of leaves in length.

After the experiment had been set up, on the eighth and eleventh days evaluation was done. The experiment was repeated three times. The rooted and treated plants were grown in a greenhouse. The formation of the total phenol content was investigated in the rooted plant as a function of time (UDVARDY—HORVÁTH 1964).

After this, shoot tips were infiltrated with thiouracil solution, and 2.2 mg/1000 ml kinetin was illuminated so that the stomas should be open and the solution could penetrate better. The cuttings used as controls were infiltrated with ion free water, and afterwards placed into the right solution and set next to the rooted plants in the greenhouse. Besides the cuttings, we worked with isolated leaves, too. The leaves were kept on filter paper soaked with thiouracil and digitonin solution in petri dishes. As controls, we used the leaves kept on filter paper and soaked with ion free water. The DNA-P and RNA-P contents were determined according to Hammersten's method (HAMMERSTEN 1947).

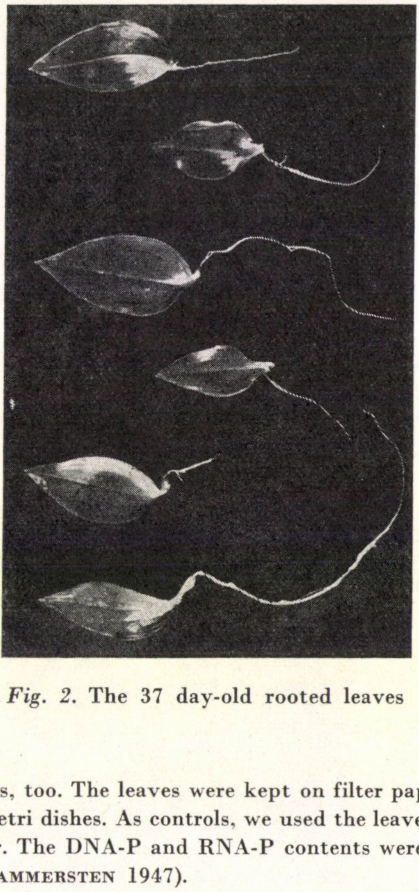

Fig. 2. The 37 day-old rooted leaves

The inhibitory effect of the thiouracil and digitonin on the rooting was determined on the 8th and 11th days of the treatment, which is summarized in Table 1. It can be clearly seen from the Table that the thiouracil and digitonin solution used in the concentrations by us, inhibited the rooting in both types of cuttings by having damaged the metabolism. The cuttings kept, in the thiouracil solution were destroyed slowly, while those kept in digitonin more quickly.

The shoots transferred daily from the ion free water into the solutions behaved the same way as the former ones. The only difference was that the rooting started in the ion free water, and with the transfer of the shoots into the solutions under question, the roots were destroyed first, in about two days then the further destruction of shoots was similar.

Table 1

The influence of different

Variant	Kept in thiouracil solution		Kept in digitonin
Shoot tip cutting	On the 8th day no regeneration, the terminal leaf grew, the shoot remained intact	On the 11th day no root regeneration, the under leaf drying	On the 8th day no regeneration, no growth in the terminal leaf, brown rotting on the under part of the shoot
Stem cutting	Neither shoot nor root regeneration, the leaves of the shoot a little dry	Same as on the 8th day: the leaves rather dry	No regeneration, brown rotting on the under part of the cutting

The formation of the total phenol content was investigated at 28 and 180 days' intervals counted from the rooting. The results are shown in Fig. 1.

From the Figure it can be seen that the synthesis of the phenolic kind of compounds increased intensively by the end of the first month. The greatest rise was reached between the 31st and 33rd days. On the 35th day, the rate of biosynthesis decreased to one fifth. This decreasing tendency — though the total phenol content had increased — affected the 150—180 day old *Tradescantia* plant, too. Bastin's experiments show that the numerical growth of the roots induced by auxin is the result of increased biosynthesis of phenolic-like compounds, whose inhibitors are the indol acetic acid oxidase ferments. The isolated leaves, kept on the ion free filter paper, were rooted on the 32nd day. The 37 day old rooted leaves are represented in Table 2.

It can be established from this Table that the DNA-P content of the leaves kept on the filter paper soaked with ion free water, shows a decreasing tendency up to the 18th day, then it begins to be increasing. This rise lasts till the appearance of the roots. By the 7th day of

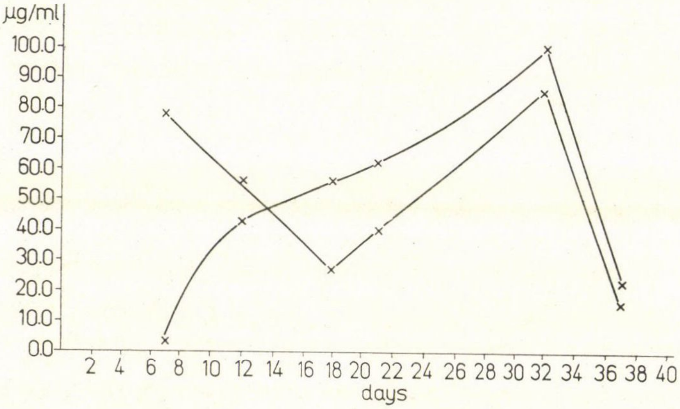

Fig. 3. The formation of the DNS-P and RNS-P content of the leaves kept on filter paper soaked with ion free water as a function of time

treatments on cuttings

solution	Kept in ion free water	
On the 11th day rotting more advanced	On the 8th day shoot grew and regeneration of root	On the 11th day same as on the 8th day but more intensive
With the exception of the upper part of the stem, completely destroyed	Regeneration of shoot began from the upper pair of leaves: 1.5 cm roots developed from the stem nodules of the under part of shoots	The same continued

Table 2

The content of DNA-P and RNA-P in cuttings

Variant	Time of treatments in days	DNS-P γ/ml	RNS-P γ/ml
Leaves kept on filter paper soaked in ion free water	7	77.70	31.80
	12	56.56	43.46
	18	27.27	56.18
	21	40.40	61.48
	32	85.85	99.64
	39	16.16	21.20
Rooted plant	From 21 days' age to 180 days' age	33.19	45.54
Terminal shoot infiltrated with kinetin solution	4	26.26	22.26
	5	22.22	21.72
Terminal shoot kept in kinetin solution	4	28.28	22.08
	5	21.21	29.68
Terminal shoot infiltrated with thiouracil solution	4	17.17	16.96
	6	41.41	16.96
	7	50.50	47.47
Terminal shoot kept in thiouracil solution	4	18.79	18.02
	5	21.21	20.67
	6	17.17	23.32
Leaves kept on filter paper soaked in digitonin solution	7	18.18	42.40

rooting, it had decreased again. The RNA-P content increased gradually until the appearance of the roots and then decreased.

The DNA-P and the RNA-P quantities are more in the shoots infiltrated by kinetin solutions. It is evident that, through the increase of DNA and RNA synthesis, the kinetin stimulates protein synthesis. The kinetin can inhibit the growth stimulation induced by the auxin, but the synthesis of proteins is not inhibited, it is contrarily increasing in the shoots.

RNA synthesis is inhibited by thiouracil. After treatment, the rooting was completely inhibited. The uracil substituted by halogens, induced false RNA synthesis through false DNA formation. The RNA-P content of the leaves kept on filter paper soaked in digitonin solution had increased by the 7th day, but the DNA-P content was very low.

The DNA-P and RNA-P content of the rooted *Tradescantia* plant, are increasing as a function of time; in this report, the mean of the days between 21–180, is given, which also expresses how the value of DNA-P is surpassed by that of RNA-P.

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CHLOROPLASTS AND BOTANICAL TAXONOMY

Recent results of cell structure investigations call attention to organoids other than the nucleus of the plant cell. In parallel with the growing importance of cytochemistry increasing stress is laid upon the photosynthetic activity of the cell and its organs: the chloroplasts. It is only natural at a time when it is generally understood, that autotrophic plants have developed through the development of the photosynthetic structure, and when macromolecular cytochemistry, cytophysics and electron microscopy have jointly composed a more and more realistic picture of the basic function, shape and structure of green plastids.

We have come to the decision of making an attempt at using the characteristics of chloroplasts and peculiarities of their structures as indexes of the phylogenetic level of the taxons of tracheophytes.

Leaves of 30 tree-, bush- and grass varieties belonging to the higher plants were used in our study. The material from which the samples were taken was chosen in a way as to represent the families (traced back phylogenetically) whose geohistorical place is well-known.

Of the families known from the upper Devonian period the family of *Polypodiaceae* was chosen, and its contemporary representatives: *Polypodium aureum* L. and *Polystichum falcatum* Diels. were examined. From the family *Cycadaceae* originating from the upper carboniferous period the now-living *Cycys revoluta* L. was studied, while from *Ginkgoaceae Ginkgo biloba* L., of the middle Permian family *Araucariaceae Araucaria bidwilli* Hook, from the upper Permian

Taxodiaceae the now-living *Sequoiadendron giganteum* BUCHHOLZ. The family *Pinaceae* is known from the transitional period between Jurrassic and cretaceous periods; our studies were performed with *Pinus silvestris* L. and *Picea excelsa* LINK. The families of *Magnoliaceae, Myrtaceae* and *Araliaceae* have been proved to derive from the lower cretaceous period. From the first family *Magnolia grandiflora* L., and *Michelia fuscata* BL., from the second *Myrtus communis* L., *Eucalyptus cinerea* Mull. and *Psidium guajava*, while from the third *Hedera helix* L. and *Fatsia japonica* were the species used in our study. From the upper cretaceous period plants of the family *Eleagnaceae* are mentioned as first remnants, from among their contemporary representatives *Eleagnus pungens* THUNB. was examined; further the *Apocynaceae* of which *Nerium oleander* L. and *Vinca minor* L., *Taxaceae* and *Cupressaceae* of which *Taxus baccata* L. and *Juniperus communis* have been represented here, since the tertiary period were also used. From the cretaceous to the tertiary period development of the families of *Ranunculaceae, Lauraceae* and *Piperaceae* is known fairly well .From the first family chloroplasts of *Helleborus caucasicus* Rgl., *Helleborus niger* L. and *Ficaria verna* HUDS. were studied. From the second family *Laurus nobilis* L., *Cinnamomum camphora* NEES et EBERM, and from the third *Piper nigrum* L. and *Piper ornatum* HORT. were used in our study. *Rubiaceae* and *Rosaceae* known from the tertiary period are the two last families in our list, of which *Coffea arabica* L. and *Rosa canina* were examined.

Generally two species of each family were used in our work, as far as it was made possible by the conditions of the Botanical Garden of the Faculty of Natural Sciences of the Komensky University, Bratislava, and by the early spring vegetation. The material of our study was collected between 15th February and the end of April, on several occasions at about 8 — 10 a.m. For the dissections samples were taken from the medium part of the shoot in order to obtain perfectly developed leaves without any symptoms of ageing or necrosis. In spite of this, we are well aware of the fact, that February, March and April were not the most suitable months, when combining greenhouse plants with those grown outside.

Leaves were collected by hand with the aid of a hand microtome and a razor. Dissections were placed at once into a 5-percent tap water solution of glucose. Preparations were studied with light microscope by using blue filter and oil immersion, magnified 600 — 900 ×. To emphasize some details of the chloroplasts we used iodine-potassium iodide solution, Sudan III and silver nitrate solution. The 0.002 — 0.004 per cent normal red solution in distilled water proved to be suitable for determining the pH value of cells. A part of the dissections was studied also with fluorescence microscope, by using a magnification of 400 — 900 times and immersion. Paraffine oil and glycerine proved suitable as the optical media of immersion. To filter out rays with undesirable wave-length 3 — 10 per cent cupric sulphate and a series of Zeiss-filters built in the microscope were used.

When studying the representatives of the individual species we found that in older representatives of the Gymnospermae the plastids had a granular structure and free granules can be detected throughout the whole mesophyll. Among gymnospermous plants used in our study *Cycas revoluta* L. can be considered to be the oldest type. Majority of the Gymnospermae shows a uniform type concerning the structure of chloroplasts. In the families of *Taxaceae* and *Pinaceae* more or less granular or homogeneous chloroplasts are found. Special attention should be paid to the study of the family *Ginkgoaceae*, the representatives of which appeared already in the upper carboniferous period with their flat foliage. With regard to the conspicuously different types of plastids of *Ginkgo biloba* L. the question arises whether the changes in plastids were caused by a considerably reduced filtration of solar rays due to the atmospheric humidity which had occurred in the transitional period between the upper carboniferous period and the Permian, or else, further development of the family was resulted by the rapidly changing paleoecological conditions. Since no other gymnospermous plant shows such definite changes we think that either the family appeared at the beginning of the medium or upper carboniferous period as a new, highly adaptive progressive gymnospermous type, or these changes took place only in the *Ginkgo biloba* L., i.e. are essentially of later origin.

In the case of older representatives of dicotyledons chloroplasts of both granular and homogeneous structure are found, the ratio being in favour of the granular types in the phylogenetically older families, while in the phylogenetically divergent orders it gives preference to the compact structure.

The ancestors of present specimens of the order of *Myrtales* are known from the layers of the lower cretaceous period. Supposedly they appeared in the upper Jurrassic or at the beginning of the lower Jurrassic under similar paleoecological conditions as those mentioned in connection with the *Ginkgoaceae*. Dicotyledons traced back to these ancestors show both plastid types in all cases studied. On this basis it is believed that the Dogger period and the beginning of the malm period had about the same requirements for higher plants as those of the end of the upper carboniferous period and the early Permian. Nevertheless, it is possible that in case of the gymnospermous *Ginkgoaceae* homogenous plastids appeared in this very period.

Comparison of representatives of the family *Apocynaceae* seems to prove that arboraceous plants are genetically older than non-arboraceous ones. *Piperales* classified recently by Novák (1961) into a lower order of dicotyledons was justified by the study on the representatives of this order.

On the basis of our studies carried out so far, concerning the determination of the phylogenetical level of individual families by using the chloroplasts of now-living plants, the following is considered as important:

Percentage proportion of chlorophyll in leaves should be determined in the majority of the paleobotanically selected species and families.

Percentage proportion of *a* and *b* chlorophyll should be determined in leaves.

Special attention should be paid to now-living families and species whose first appearence can be proved photochronologically.

Results obtained should be compared with revealed facts of geohistory and paleoecology.

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PIGMENTATION IN THE RED PEPPER VARIETY E 15 WHEN FRUITS ARE PICKED UNRIPE

Recently several hundred samples have been taken yearly from the paprika fields of Szeged and Kalocsa. While taking the samples we observed that the growers often picked half ripe brownish-blackish-red and sometimes green fruits. The dry matter content of E 15 red pepper fruits picked when half ripe was examined in test series. According to our data half ripe fruits proved to have 0.4—2.0 per cent lower dry matter content than ripe, red fruits. Benedek (1959) examined the composition in post-ripened fruits of paprika varieties grown in the district of Szeged. He found an average of 15 per cent less pigment in fruits picked when half ripe.

In 1968 more than 60 per cent of the paprika yield in Hungary consisted of the red pepper variety E 15. The question arose whether the variety E 15 behaves similarly to the paprika varieties examined by Benedek. The composition of the initial material was not examined at Szeged, since there had been abundant data available on the pigment content of the "Szegedi" varieties (Benedek 1952, 1958). Therefore in 1968 we started examinations on green, half ripe and ripe fruits of the variety E 15.

The examined material consisted of fruits of the red pepper variety E 15-grown by three co-operative farms. The samples were taken on the 23rd September 1968, from the plots of the

1) "Béke" Co-operative Farm, Foktő,
2) "Úttörő" Co-operative Farm, Ordas and
3) "Iszkra" Co-operative Farm, Kalocsa.

All fruits picked were larger than 9—10 cm, and even the green ones seemed to be completely developed. 1 kg of each 3 kg fresh sample was used for the determination of dry matter-and pigment content, while 2 kg per each were stringed. The strings were stored for 40 days in airy, partly sunny places protected from rainfalls. Following the post-ripening the cleaned and dried pericarps were milled so finely as to pass through a sieve of 0.75. Moisture content of the milled product was 10 per cent. It should be mentioned that the dry matter content was determined immediately after picking, while pigment content only 2 or 3 days later. Consequently, the pigment content values are characteristic of a somewhat post-ripened paprika. The dry matter content was determined through drying, the pigment content by BENEDEK's method (1958).

The results of examinations are presented in Table 1.

Table 1

Examination data of paprika fruits picked when red (ripe), half ripe and green

Samples		After picking		Following 40 days of post-ripening	
number	stage of development	dry matter content %	pigment content g/kg	pigment content g/kg	pigment increment %
1	red (ripe)	16.8	3.60	4.37	19
	half ripe	15.9	2.22	3.34	51
	green	11.9	0.29	*a* 1.91	560
2	red (ripe)	17.2	3.32	3.94	18
	half ripe	16.8	1.90	3.34	76
	green	11.7	0.21	*a* 1.84	780
				b 1.00	380
				c 0.39	86
3	red (ripe)	17.0	3.66	4.56	27
	half ripe	16.3	1.46	3.43	135
	green	14.3	0.30	*a* 1.90	530
				b 0.85	183
				c 0.90	0

Red pepper fruits picked when half ripe all turned red during post-ripening. After the 40 days of storage fruits that had been picked when green were distributed into three groups according to the extent they became red. Red fruits were graded into group *a*, yellowish red ones into group *b*, while those which remained green were graded into group *c*. Differences in pigment content between the groups are well shown by the *a*, *b*, *c* values of Table 1. These values also show that there may be three stages of development in green paprikas — even if they are not perceptible to the eye. Fruits in group *c* — though fairly developed — proved to be biologically unripe.

When studying the relation of the pigment content of half ripe paprika fruits to that of red-ripe ones we find significant differences (Table 2).

The differences are even greater when pigment contents of paprika fruits picked green and of those post-ripened are studied. Here the mean value of the pigment content in fruits that have turned red is 1.88 g/kg, i.e. only 44 per cent of the 4.29 g/kg value of ripe fruits. The results are similar to those found by BENEDEK in 1959.

To sum up what has been said, pigment content in the red pepper variety E 15 was more than 20 per cent lower with fruits picked when half ripe and — at the best — more than 50 per cent lower with those picked when green, as compared with the pigment content of ripe, red fruits. Therefore, in order to increase the pigment content, growers must by all means be persuaded to pick fruits when they are completely red and ripe. The best method would be the one suggested by BENEDEK in 1964, namely, if paprika fruits were partly post-ripened while on the plant.

Table 2

Pigment content comparison of red (ripe) and half ripe paprika fruits following the post-ripening

Pigment content following 40 days of post-ripening			Difference (less)	
Number of samples	picked when red	picked when half ripe	absolute g/kg	per cent
1	4.37	3.34	1.03	23
2	3.94	3.34	0.60	18
3	4.56	3.43	1.13	25
Mean value	4.29	3.37	0.93	22

*

Prepared at the National Institute for Agricultural Quality Testing, Budapest.

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STUDY ON THE VOLATILE OIL EXCRETORY SYSTEM OF SALVIA OFFICINALIS L. AND S. SCLAREA L.

Ever since ancient times *Salvia officinalis* L. and *S. sclarea* L. have been plants of great importance from both pharmaceutic and industrial points of view (MADAUS 1938, GESSNER 1953, HEEGER 1956, LODI 1941, DRAGENDORFF 1898, HOPPE 1958, BOURNOT—GILG—SCHÜRHOFF 1927, Pharm. Hung. VI. 1968, HALMAI—NOVÁK 1963). At present in Hungary these two Mediterranean plants are partly grown, partly imported as drugs (*S. sclarea* often runs wild and gets acclimatized (STIEBER 1951)). Despite that since the last century many have studied

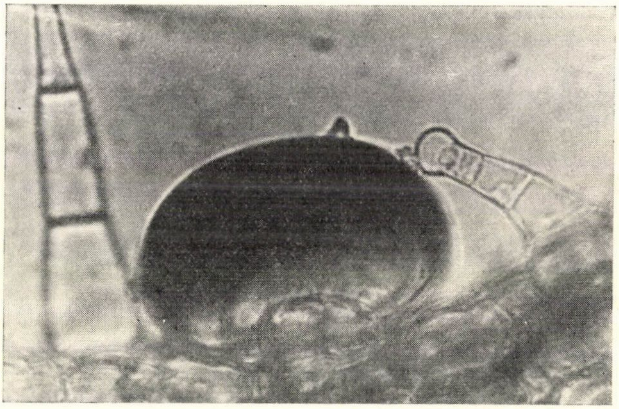

Fig. 1. Labiatae-type volatile oil-gland and glandular hair. 500×

leaf anatomy of these plants (Vogl 1887, Tschirch—Oesterle 1900, Tschirch 1917, Solereder 1899, Moeller 1905, Metcalfe—Chalk 1950), the precise anatomical structure has not yet been made clear. We have aimed at the study of the volatile oil excretory system and as a first step investigated the excretory system of the mature leaf.

We obtained *Salvia officinalis* shoots from the Botanical Garden of the University of Budapest, and *S. sclarea* shoots from the State Farm of Dkiránypuszta (South-Western Hungary). The living material was studied with a Zeiss stereo-microscope, while the preparations (sections, preparations stained with toluidine blue and cleared, epidermis preparations) with a Zeiss Nf microscope. 25 microscopic measurements with several replications were made at apices, centres, bases and edges of 5 leaves in order to determine the size and frequency of excretive glands and vein-islets. It is necessary, however, to check by further measuring the conclusions drawn from more than 3000 measurements.

Instead of discussing the anatomical structure in detail we point out here several essential circumstances only. The vein-islets of both species are highly protruding; from above they look like "hills", from below like "basins". In *Salvia officinalis* they are on the same level,

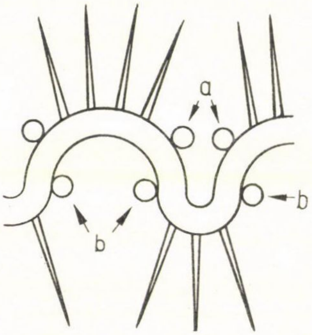

Fig. 2. Roughly outlined cross-section of a *Salvia officinalis* leaf. a = large glands on the upper surface; b = large glands on the lower surface

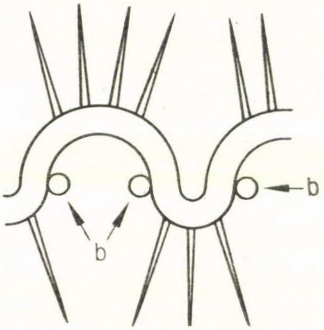

Fig. 3. Roughly outlined cross-section of a *S. sclarea* leaf. Explanation of signs as in Fig. 2

while in *S. sclarea* they form a storey system. With *S. officinalis* both leaf surfaces are covered with thick hair, while in the other species the hair on the upper leaf surface is thinner; trichomata are always located on the "hilltops" and at the edges of the "basins" respectively. Below this trichoma-zone are found the large *Labiatae* glands (Fig. 1) which in the "valleys", i.e. on the upper surface of *S. sclarea* and mostly also at the bottom of the "basins" are absent (Figs 2, 3). Tiny glandular hair with unicellular or multicellular stalks and with uni-, bi- or multicellular heads occurs in both species (Fig. 1). On the lower surface of *S. sclarea* in the trichoma zone short strigae are also round.

Summarized and averaged results of microscopic measurements are subsequently presented in tables. Signs used in the tables are explained as follows: a = upper leaf surface of *S. officinalis*, b = its lower surface; c = lower leaf surface of *S. sclarea;* A = apex of the leaf blade, M = margin of the centre, C = centre, B = base; n = average number per vein-islet of developed large glands, d = their average diameter in microns; m = average number per mm^2 of vein-islets; mn = average number per mm^2 of large glands.

	n				d			
	A	M	C	B	A	M	C	B
a	3.43	4.05	3.35	3.62	67.4	61.8	66.6	65.5
b	8.75	8.79	5.56	6.15	69.0	57.4	66.3	66.6
c	2.38	2.88	1.76	1.88	82.3	82.1	78.8	74.2

	m				mn			
	A	M	C	B	A	M	C	B
a	2.53	2.65	2.44	1.48	8.68	10.7	8.19	5.37
b	2.53	2.65	2.44	1.48	22.1	23.3	13.6	9.12
c	0.92	1.51	1.00	0.92	2.19	3.31	1.77	1.73

In the possession of these data relative spatial changes in volatile oil production can also be expressed mathematically. For this purpose one of the data is compared with the others. We chose the lowest mean value as a unit. In this case relative volatile oil production per vein-islet (I) can be expressed with the following formula constructed by us:

$$I = \frac{\frac{r^3 \pi 4}{3} n}{\frac{r_B^3 \pi 4}{3} n_B} = \frac{r^3 n}{r_B^3 n_B} \tag{1}$$

Relative volatile oil production per unit area (Φ) is given by the following formula:

$$\Phi = \frac{\frac{r^3 \pi 4}{3} n\, m}{\frac{r_B^3 \pi 4}{3} n_B\, m_B} = \frac{r^3 nm}{r_B^3 n_B m_B} \tag{2}$$

In these formulas r_B, n_B, m_B mean the lowest radius, n- and m values taken as bases. Data counted with formula 1) are presented in Fig. 4, while those counted with formula 2) in Fig. 5.

From the numerical results we can see that the number of large glands — both per vein-islet and per unit area — shows always maximums at the edges of leaf blades and minimums in the centres and at the bases respectively. On the other hand, developed gland diameters show minimums at the leaf edges of *S. officinalis* and at the leaf bases of *S. sclarea.* Number per both vein-islet and unit area of large glands is the highest on the lower leaf surface of *S. officinalis* and the lowest on the lower leaf surfaces of *S. sclarea*. Their diameters — on the other hand — are the largest on the lower leaf surface of *S. sclarea*. The number of vein-islets per unit area in *S. officinalis* is much higher than in *S. sclarea*. When considering the Fig. of values I. (Fig. 4) we can see that the lower leaf surface of *S. officinalis* is present everywhere with higher figures than its upper leaf surface and the lower leaf surface of *S. sclarea* respectively. The curve of the Φ values (Fig. 5) shows that the values of the lower leaf surface of *S. officinalis* (4—10) are much higher than either those of its upper leaf surface (2.3—3.8) or lower leaf surface values of *S. sclarea* (1—2.6). Otherwise, in both species the highest Φ values are found at the edges and apices of the leaves. It must be emphasized again, that our results are based on examinations of only a low number of samples and further control studies are required to draw final conclusions. However, if they are justified, significant conclusions can be drawn from them for thepractice as well. For example, growing and import resp. of types with long and narrow leaves (e.g. *S. officinalis* ssp. *lavandulifolia* or ssp. *minor*) seem now to be more favourable. Anyway, we consider the anatomical method introduced by us and discussed above as useful and advisable for the practice too.

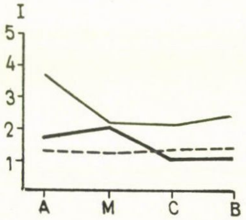

Fig. 4. Changes in factor I. Thin line: lower leaf surface of *Salvia officinalis;* broken line: its upper surface. Thick line: lower leaf surface of *S. sclarea.* Other explanations in the text

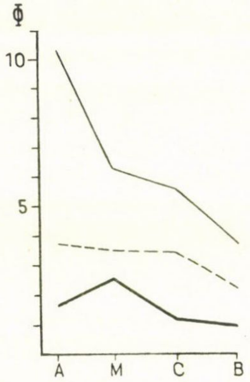

Fig. 5. Changes in factor Φ. Explanation in Fig. 4

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*

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COMENIUS AT SÁROSPATAK

1650—1654

Human knowledge on natural sciences has made a greater progress in this century than in all the nineteen before. Discoveries and innovations are continually increasing in number. The necessity of systematizing, spreading and utilizing this knowledge presents an urgent task. All these are primarily the duties of pedagogy. What is the easiest way of acquiring the necessary knowledge, and what is it most efficiently utilizable for — are the most important questions of our days.

The great teachers of human society answer the above questions. Among them there are some whose work have not only meant enrichment for their own country and contemporary society but also guidance for all times. One of them is Comenius Amos János whose books are of everlasting value.

His great works published in succession have had their tercentenary in the recent years. "Opera didactica omnia" (Collection of his pedagogical works) was published in 1657; its third part contains Comenius' studies written at Sárospatak; "Orbis sensualium pictus" (The tangible world in pictures) was written in Latin and German in 1658 while its first Latin—German—Hungarian version was completed in 1669.

Timeliness of his works is increased by the renewed international — and especially Czechoslovakian—Hungarian — cultural relations which have led to careful preservation of the Rákóczi relics there and of the Comenius relics in this country.

The world-wide student demonstrations point to causes which were recognized already by Comenius and which led him to open new fields of didactics and methodology.

His last work in which he urged world peace was written in 1670. He died in Amsterdam in the same year.

Requirements and objectives of our time wrestling with the difficulties of teaching and learning lead us to recognize Comenius' timeliness. Namely, pedagogy returning to nature and progressing simultaneously with it is an inexhaustible source of true knowledge. The highly important questions of what, how and for what purpose to teach and learn respectively were answered by Comenius.

At a time as many as three villages competed in Moravia for being able to call him their native. His adopted name (Komnyanszki — Komensky = Comenius) originated from the village of Komnya; once he claimed he came from Nivnice, another time from Magyarbród. He was born in 1592 of poor parents who soon died. Owing to his adverse circumstances he could only begin to learn at the age of sixteen. However, due to his untiring industry and sharp intellect he finished school within a remarkably short time; by 1614 he became a teacher, then a schoolmaster, text book writer and educational reformer whose extensive reforms laid the foundation of education for the following centuries. We, Hungarians are proud of having had a closer connection with him: he lived in the ancient College of "Athen by the river Bodrog" at Sárospatak for nearly 4 years; he worked at the school of the Rákóczis at that time. Though it was a short period — from 1650 to 1654 — it was remarkable: a presentation of his basic method of 1) teaching natural sciences and 2) learning more easily by visual aids and sensory experiences.

JOH. AMOS COMMENII,
ORBIS SENSUALIUM PICTUS.
Hoc eſt,
Omnium fundamentalium in Mundo Rerum & in Vitâ Actionum
Pictura & Nomenclatura.
Die ſichtbare Welt /
Das iſt /
Aller vornemſten Welt-Dinge und Lebens-Verrichtungen
Vorbildung und Benahmung.

NORIBERGÆ,
Typis & Sumptibus MICHAELIS ENDTERI.
Anno Salutis [illegible] LVIII.

Fig. 1. The title-page of Comenius' "Orbis sensualium pictus" (Visible World)

There were more than one reasons and aims of his coming to Hungary. His arrival was preceded by fame and several books, to mention but a few: "Renewed physics" is a confession of his ideology, "Maternal school" is the very first book on infant education. "Janua, the opened door of languages" had been used as a text book at the school of Sárospatak even before he came to Hungary. He introduced items from the "Rules of school" in Hungary too, and his other world-famous work "Schola ludus" written at Sárospatak was inspired by another book of his: "School dramas".

It was Hungarian students studying abroad who brought news of him and his work to the Rákóczis, patrons of the College at Sárospatak, and to its professors. Among the latter were János Tolnai Dali, known also in Holland and England, and other famous foreign professors: Alstedius, Piscator — Comenius' former teachers in Herborn — and Bisterfeld who graduated after him at the same university.

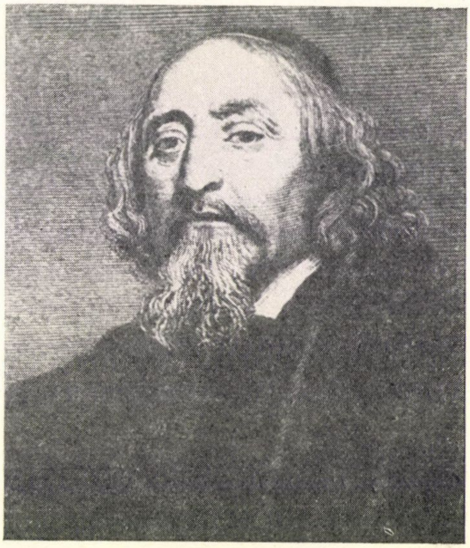

Fig. 2. Comenius' portrait

But news was also brought abroad about the conditions of ancient Hungarian and Transylvanian colleges. Students enrolling at foreign universities forwarded to Comenius the invitation of the Rákóczis and professors. This mutual interest was the first but not the only reason for Comenius' coming to Sárospatak.

His decision as to the acceptance of any of the invitations was influenced by political factors as well. The Thirty Years' War broke out in 1618; Comenius and the community of the "Czech brethren" in general were sorely tried. They had to flee and Comenius went to Lissa, Norköping, London, Elbing to gain international support for his country. The task of comforting and keeping together his fellow brothers of the same faith and nationality who found a new home on the estate of György Rákóczi I. at Lednice, as well as the "prophecies" of his friend Miklós Drabik, stating that their efforts could be best realized by the help of the Rákóczis were the motives that directed his steps towards Hungary.

We should mention the gratitude towards Hungary he and his "Czech fellow brothers" felt who took part at the unity conference at Lissa in 1650. It was already 22 years at that time that Hungary had been helping several thousands of Czech refugees. The conference adopted the resolution of allowing their bishop to settle down and work at Sárospatak.

After three centuries "Comeniology" was given a new stimulus. The investigations have been extended to stock of the great educator and to the etymology of his name. The most important evidence was given by Comenius himself who used his original surname on his last work which was found recently. Unanimous opinions of Czechoslovakian and Hungarian researchers suggest that his father's name was Márton Szeges. Here we cite the words of our eminent philologist, József Bakos dr., the excellent Comenius-researcher: "It is supposed that his ancestors came to the old military frontier of Hungary at the time of colonizations in the 10—13 th centuries, and from there to the nearby Moravian villages of Komnya, Nivnice and Uhersky-Brod (Magyar-Bród). On the other hand, the name Szeges — as I have proved it etymologically — is undoubtedly Hungarian". This fact may have played — consciously or unconsciously — a role in Comenius' coming to Hungary and working at Sárospatak.

Fig. 3. Comenius' bust at Sárospatak

Let us have a look at the educational reforms introduced by Comenius at Sárospatak. The school at Sárospatak was previously attended by boys but not compulsorily. Its two sections corresponded to the secondary and high schools nowadays. It was supervised by the clergy. The students had the power of disposing of the properties of school — rights and real estates given by its patrons. Older students were teachers to the lower section. Poor students did housework as "servant students" at the private lodgings of rich students for full board and instruction. Progress was secured by lectures and examinations. Modern languages and sciences were not taught, Latin was the principal and only subject matter. Even the vernacular was not cultivated. Strokes and confinement (carcer) were also employed as means of discipline.

Comenius introduced radical changes. On the request of Zsuzsanna Lorántffy, wife of György Rákóczi I and of Zsigmond, their son, he prepared a plan for the reorganization of the Sárospatak school according to the "laws of pansophy". It was his first opportunity to put into practice all he had dreamt in Lissa.

His pansophy is the encyclopedia of acquired scientific knowledge of sky, earth and man, i.e. a comprehensive philosophy. Its sources are: nature, human intellect and revelation. The school of pansophy is the interpreter of universal wisdom. It wants to teach everybody (omnes) everything (ad omnia) in its totality (omnino) in order to prepare people both individually and collectively for a right, peaceful and happy life. Comenius gave "magna didactica" and "bona methodica" to these high objectives, and made his own terms: 1.) free hand and moral support in realizing his school reforms; permanent teachers employed for each class; to put into operation the existing press; free board provided for several Moravian students (educational affairs); — 2.) further patronization of Moravian refugees (politics); — 3.) enough money for building up the necessary establishments — boarding house for students, class-rooms, etc. (finances).

"My terms were accepted and all my wishes were promised to be fulfilled" — wrote he in his memoir. His personal requirements were also provided generously: "The salary of the famous reverend A. J. Comenius at Sárospatak from 1651 was: 600 gulden cash money, 60 köböl of wheat (1 köböl = cca 25 gallons); 40 gulden for clothes, 15 barrels of wine, 6 pigs, 15 lambs, 15 icce of honey (icce = old liquid measure = 0.88 litre), 25 icce of butter, 2 köböl of peas, 1 köböl of lentis, 1 köböl of husked millet, 2 barrels of cabbage, 25 carts of firewood. In case of common support settled we undertake the keeping of 12 young men from among his compatriots". These lines are read in the household records of Zsuzsanna Lorántffy.

Thus, Comenius was able to develop the first complete school system. He took the order of nature for basis and divided the developmental period into four parts: infancy and childhood, adolescence and youth. The corresponding types of school are: maternal lap, public elementary school, Latin school or gymnasium and college or academy with extension tours abroad. His gradually extended curriculum, the pattern of lessons and breaks were exceptional in the history of education up to his time. The students were excused from managing the finances of the school. (Though at that time this seemed derogative to the students.) He claimed collective maintenance and a common dining-hall for all poor students. In order to make the students acquire the knowledge of natural sciences he included physics, geography, history, chronology and ethics in the curriculum besides the subjects of the "seven free arts". In his opinion teaching should be started in the respective mother tongue, and foreign languages should also contribute to positive knowledge. These were bold reforms both from organizational and educational points of view. "What" (quid) is to be done, then?" Only, what is useful for life. The conditions of success are given in nature. "Man has to be master of nature."

Since, however, "nothing reaches the intellect before getting to the senses" — he introduced — as again first in the world — visual teaching. For this method he elaborated the first illustrated text-book: Orbis sensualium pictus (The tangible world in pictures) in which he himself drew the pictures. In order to facilitate learning and teaching he submitted the subject matter to sensory experiences — another revolutionary method adopted since then by every nation.

The "Orbis pictus" with its pictures and explanations informs the reader on everything that happens in sky, on earth and to man. Creation, astrology, production, utilization were demonstrated in it, according to what the author thought of the parts of the universe. For example, concerning the solar system, he was of the same opinion as Copernicus. The stars are not flat disks, "they are balls". They are not motionless, "they turn round an axis". "The axis is determined from both sides by the two poles of the sky". "The ball of earth turns round in 24 hours . . . " (O.P.CIII.). "Corn grows on a stalk with heads on and produces grains in the ears . . . " (O.P.XVI.).

For technical reasons (xylography) this world-famous book completed at Sárospatak was published first in Nürnberg, 1658, in Latin—German. The first Latin—German—Hungarian version was published also here in 1669. Between 1675 and 1842 it had 21 editions in this country, including 16 in Hungarian. With this work Comenius answered the second important question of pedagogy: "how" (quomodo) to teach and learn.

Comenius' "Schola ludus" contains didactic plays — eight school dramas. The first performance of his plays was in 1654. The book was first published at Sárospatak in 1656, at Zsuzsanna Lorántffy's expense.

Comenius acknowledged the necessity of discipline but suggested humanitarian and more righteous methods. He made distinction between educational and moral faults. In the former case he rejected corporal punishment and approved of it in the latter case only when anything else had failed. Persuasion, praise, exemplary conduct should primarily be the means of discipline, without the two extremities of excessive tolerance and crude rigour. For this purpose he made "Moral precepts" and "School regulations". He exposed laziness, immorality and indecency. He wrote essays "On books", "On the method of education", "On hindrances of pansophy".

New, revised editions of the "Vestibulum", "Janua" and "Atrium" were prepared at Sárospatak. He even had time to deal with the third question of pedagogy as "to what purpose" (cur) to teach, from social and political points of view. Here he wrote the following: "Marriages could be efficiently promoted by lessening the burdens". "By improving our life we should try to make our neighbours friends" (Gentis felicitas).

He left Sárospatak and Hungary in the middle of 1654. His political conceptions, i.e. liberation of his country by the Rákóczis could not yet be realized at that time. His political and educational objectives required more than one generation to come true. However, it was at Sárospatak that his proclamation published later in Amsterdam was conceived: Peace for the world! Unum necessarium! He summarized the human duties as: "Everyone should do his utmost" for peace and unity in human society!

His "Collected works" (Opera didactica omnia) consisting of four parts were published in Amsterdam in 1657. The third part contains exclusively his works written at Sárospatak, which were brought him by students going to Utrecht to continue their studies.

In the international Comenius-year of 1958 the Hungarian Academy of Sciences held a special session at Sárospatak in honour of Comenius. In the old school building restored by the Ancient Monument Protectorate an exhibition was organized by a local community of the presbiterian church. Here can be seen the only Hungarian statue of Comenius made by Miklós Vay in 1859. Another statue of his erected in 1892 was destroyed in Transylvania. His third statue is being made now by Pál Pátzay, a sculptor in Budapest, as commissioned by the municipality of Sárospatak, and will be unveiled in the garden of the old school at the students' festival in Sárospatak later this year.

"He made Sárospatak a pulpit" — writes Lajos Rácz dr., a late successor of Comenius and rector at the pedagogic department, in his book on Comenius — "wherefrom he propagated his advanced educational principles to the whole civilized world, and by doing so he made the name of the College at Sárospatak known forever in the history of education".

We may add: his name as well.

Z. KIRÁLY

EFFECT OF HIBERNAL ON THE GERMINATIVE ABILITY OF PLANTS

A study on the effect of derivatives with slightly different structures may be — also from a general biological point of view — important for both higher and lower living organisms. Knowing the general effect of certain compounds used in therapy and pharmacology respectively on the metabolism or other phenomena of life, we are justified in studying their influence on certain life processes of plants, too. It is of considerable interest, since the effectiveness and toxicity respectively of the derivatives of certain groups of compounds can be gauged by certain highly responsive plant physiological or developmental phenomena. It may occur that a molecule of some drug is effective on a plant pathogen, too or is utilized by its altering some physiological process. It is enough to mention the colchicine, which is too toxic as a cytostatic chemical but in plant breeding is a useful alkaloid causing polyploidy.

The effect of cytostatic chemicals (Degranol, Merapid) on the division of algae as well as on the growth of wheat-, maize-, mustard- and other seedlings was studied by PÉTERFI *et al* (1959, 1965). MARÓTI (1967) examined the effect of the same drug on the callus tissues of tobacco, moreover, he followed the quantitative changes of nucleic acids and proteins, too. BALOGH—FRENYÓ (1967) performed also their studies with cytostatic chemicals and demonstrated the metabolic changes by measuring respiration and catalase-activity and the growth of radicles. As test plants they used potato, kohlrabi, carrot as well as yeast suspension. According to the results of their experiments the effect of cytostatic chemicals can be mostly proved by the reduced growth of mustard radicles.

The phenothiazine derivatives are compounds of enzyme inhibiting nature (ALLENBY—COLLIER 1952). In the brain cells they primarily reduce and inhibit respectively oxidative phosphorilation and ATP-ase activity (DECSI—MÉHES 1958). Knowing their general effect on metabolism we examined whether they influenced germination, one of the most sensitive processes of plants. In our previous paper (SZABÓ—HAITS 1968) we have already pointed out that it was Tisercin that reduced the germination of barley the least of all phenothiazine derivatives followed by Pipolphen and Hibernal. Germinating power was determined 10 days after treatments with 0.01 per cent solutions.

In our present work we have examined the extent to which germinative ability of various seeds soaked for different times in Hibernal solutions of different concentration is influenced. We have tried to complete our experiments with viability tests and chromosome examination. In addition we have studied whether cystine which compensates the inhibitor has some effect on the root growth of seedlings, and whether certain germination stimulating compounds, such as gibberelline and indoleacetic acid, influence the effect of Hibernal treatments.

For our examinations we selected plants showing different sensitivity to germination inhibiting and stimulating substances respectively, in order to determine which plants were highly responsive and which reacted to a less degree.

We performed our examinations by using Hibernal, i.e. 3-chloro-N (3'-dimethyl-amino-propyl)-phenothiazine hydrochloride in dilutions of 0.01, 0.1, 0.5 and 1.0 per cent. The treatment consisted of soaking the seed for 4 and 24 hours respectively. Solutions of different concentration were made with two solvents: distilled water and common tap-water in order to determine whether there was any difference in effectiveness between the slightly troubled colloidal solution made with tap-water and the clear real solution made with distilled water.

The following grains and seeds respectively produced in 1967 were used in our germination tests (names of varieties in brackets): winter wheat (Bezostaya 1), winter barley (Lédeci Beta), oats (Tápláni zászlós), flax (Szerepi olajlen), poppy (SB morfine poppy), tomato (Kecskeméti Konzerv), soybean (Pannónia 8), red clover (Hungaropoly) and alfalfa (Tápiószelei 1). Germination was carried out in Petri-dishes and on faience plates, in Polikeit germinators at

24 °C in 3×100 replications. Seed soaked in tap-water or distilled water — according to the given method — was used as control.

In order to release the action of Hibernal, highly responsive wheat grains and flax seeds were submitted to an additional plant hormone (gibberellin of 100 and 300 ppm respectively, and indoleacetic acid of 100 ppm) treatment.

The 0.1 per cent cystine solution and 1.0 and 0.1 per cent Hibernal solutions were used in alternating treatments and their effects on the development of one day old barley seedlings were observed. Alternating treatments lasted for 24 hours each. After the first treatment the examined material was transferred to Petri-dishes onto filter paper soaked with the solution of the next treatment.

For the viability test of wheat embryos we employed — instead of triphenyl-tetrazolium chloride used in plant physiology — a 0.5 per cent dilution of p,p'-diphenylen-bis-2(3.5-diphenyl)-tetrazolium chloride (Neo-Tetrazol or ditetrazolium chloride) used in human histology as well as 5 per cent dilution of acidic fuchsine used in botany.

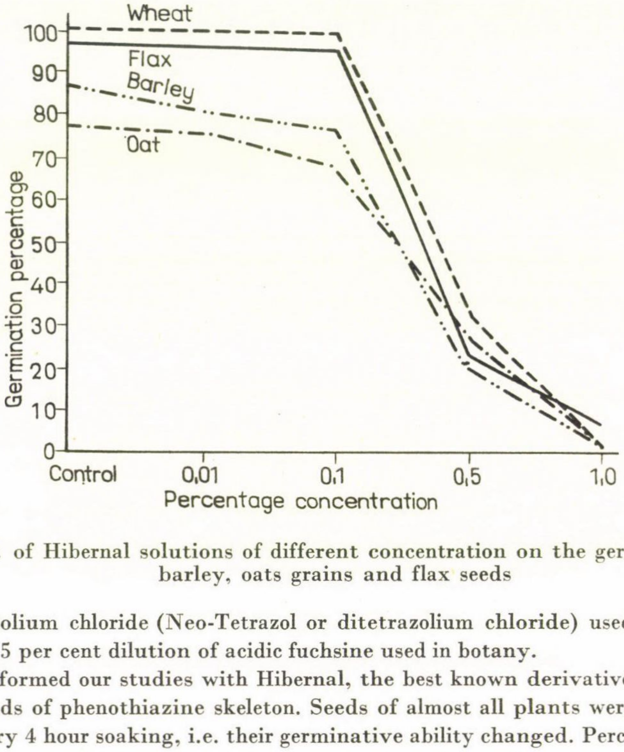

Fig. 1. Effect of Hibernal solutions of different concentration on the germination of wheat, barley, oats grains and flax seeds

We performed our studies with Hibernal, the best known derivative of therapeutically used compounds of phenothiazine skeleton. Seeds of almost all plants were highly responsive to a preliminary 4 hour soaking, i.e. their germinative ability changed. Percentage germination of each plant decreased. The only exception was — in an interesting way — soyabean because samples treated with solutions of any but 1.0 per cent concentration had germinated better than the easily moulding control — due probably to the inhibiting effect of mould damage. In these samples hardly any mouldy seed occurred.

Grains of cereals (wheat, barley, oats) and flax seeds are highly responsive to concentrations, higher than 0.1 per cent as shown by a sudden decrease in percentage germination. Poppy seeds were the most susceptible; even with a solution of 0.5 per cent applied the proportion of germinated seeds fell below 10 per cent (Figs 1, 2).

Alfalfa and red clover seeds were less sensitive; germination percentage of alfalfa seeds was about 10 per cent even with the distilled water solution. Tomato seeds were the least responsive; with a concentration as high as 1.0 per cent of Hibernal they germinated over 50 per cent.

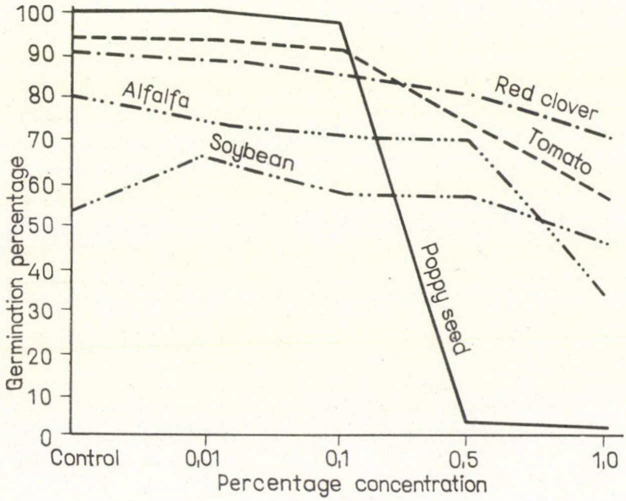

Fig. 2. Effect of Hibernal solutions of different concentration on the germination of poppy, tomato, red clover, alfalfa and soybean seeds

Hibernal solutions made with distilled water proved to be more effective than those made with tapwater due to the fact that diffusion is higher in a real solution and the compound thus has a stronger effect. That is why even a concentration of 0.5 per cent reduces considerably the germinative ability — especially of wheat, barley and oats.

The action of Hibernal depends also on the duration of the pre-treatment. Studies regarding this question were performed with flax and wheat. In a high dilution, 0.01 per cent concentration, the germinative ability was not significantly reduced even by a 24 hours treatment, while with a 0.1 per cent concentration it decreased considerably: germination percentage of flax seeds treated for 24 hours was 3 per cent at the best and wheat also showed a decrease of about 50 per cent.

We tried to compensate the germination inhibiting effect of Hibernal by treating the seeds with germination stimulating phytohormones and washing and soaking them in water respectively. A 24 hour after-soaking in water, 100 ppm and 300 ppm gibberellin and 100 ppm indoleacetic acid respectively did not alter the germinative ability.

Germinative ability of seeds did not change a week after the treatment either. It is supposed that in a concentration of more than 0.1 per cent Hibernal has a toxic effect on the majority of seeds examined and inhibits germination permanently. This is proved also by the fact that prepared wheat embryos were stained in a peculiar way. We used neo-tetrazolium

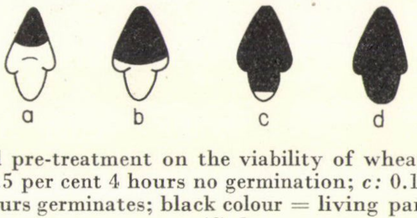

Fig. 3. Effect of Hibernal pre-treatment on the viability of wheat grains. *a:* 1.0 per cent 4 hours no germination; *b:* 0.5 per cent 4 hours no germination; *c:* 0.1 per cent 4 hours germinates; *d:* 0.01 per cent 4 hours germinates; black colour = living part of the embryo; 50 times magnified

chloride to demonstrate the dehydrogenase enzyme, which plays an important role in starting germination. In that part of the embryo containing living cells this compound is reduced to purplish claret formazane. Fig. 3 shows that 1.0 per cent Hibernal has injured a considerable part of the embryo, only the upper part of the plumule remained viable, but this is known to be insufficient for starting germination. Under the influence of the 0.5 per cent solution – though the plumule remained – the very important radicle was no more viable. After a treatment with 0.1 per cent solution majority of the prepared embryos was still viable, a large

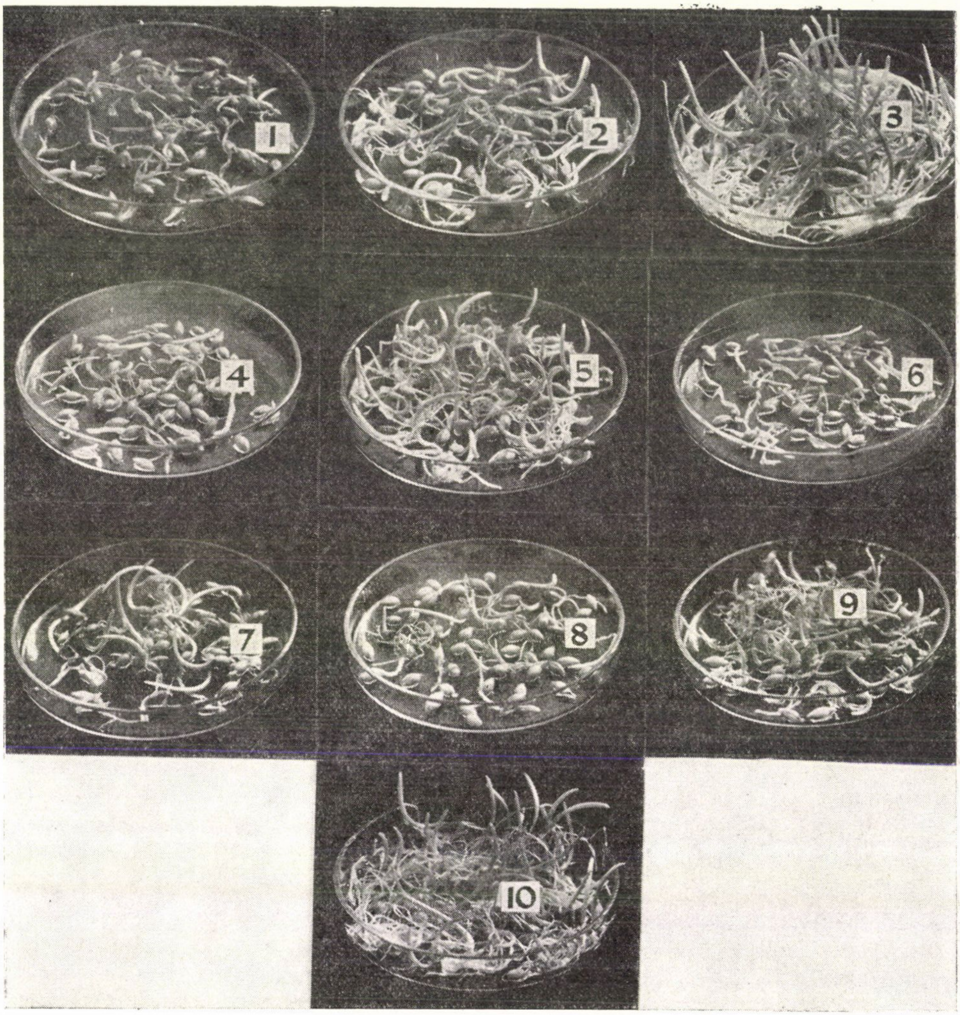

Fig. 4. Effect of 24 hours alternating treatments with Hibernal and cystine on the root growth of one day old barley seedlings. (Photos by Mrs. Mesch) 1: 1.0 per cent Hibernal; 2: 0.1 per cent Hibernal; 3: 0.1 per cent cystine; 4: 1.0 per cent Hibernal, then 0.1 per cent cystine; 5: 0.1 per cent Hibernal, then 0.1 per cent cystine; 6: 1.0 per cent Hibernal, then distilled water; 7: 0.1 per cent Hibernal, then distilled water; 8: 0.1 per cent cystine, then 1.0 per cent Hibernal; 9: 0.1 per cent cystine, then 0.1 per cent Hibernal; 10: distilled water

part of the radicle readily stained and germination was also much better. As compared to the control, the 0.01 per cent solution had hardly any effect, only the radicle tips of some embryos remained unstained. Staining with acidic fuchsine gave the same result, But with a reverse colour index; viz. this compound does not stain red the living cell part of the embryo.

As the radicle of the embryo is essentially injured influence of Hibernal on the development and growth of the roots of barley seedlings has also been examined.

Hibernal treatment during 24 hours in 0.1 per cent concentration inhibits the root growth but slightly, thus, according to the results of our experiments, seedlings have developed into normal plants. Cystine as known of its protective effect (Donhoffer 1961) being applied in an after-treatment in 0.1 per cent concentration has slightly increased the percentage of normal seedlings (Fig. 4).

1.0 per cent Hibernal solution had a decided toxic effect — not only on the germination but also on root growth. Roots got thinner, then withered, thus we gained very few normal seedlings. Young plants developed from these seedlings became — sooner or later — yellow. Fig. 4 shows the effectiveness of each treatment and treatment combinations as well as the fact that cystine is unable — according to our investigations — to compensate the germination — and root-growth inhibiting effect of the 1.0 per cent Hibernal solution.

With the view of extablishing a possible mitosis disturbance we made dissections of flax and wheat root tips and found that in radicles originating from seeds treated with 1.0 per cent Hibernal and germinated in a low percentage no mitosis disturbance occurred.

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THE FIRST EVIDENCE OF PREHISTORIC VINE GROWING IN HUNGARY

Grape, i.e. wine production has considerable importance in Hungarian agriculture. Hungary is among those that are on top of the world list by taking the twelfth place with her 247.000 ha vineyard area (HEGEDÜS—KOZMA—NÉMETH 1966). Hungarian wines are world famous and a considerable amount of them is exported. It is of interest, both from scientific and practical points of view, to know the history of vine growing in Hungary. It is known that a good deal has been done in this respect by both Hungarian and foreign research workers; instead of giving a long list we refer to one of the recently published summaries of the subject (HEGEDÜS—KOZMA—NÉMETH 1966). No material proof of the prehistoric occurrence of vine has been found so far in Hungary. Subsequently we report briefly on the first evidence of this kind found by us.

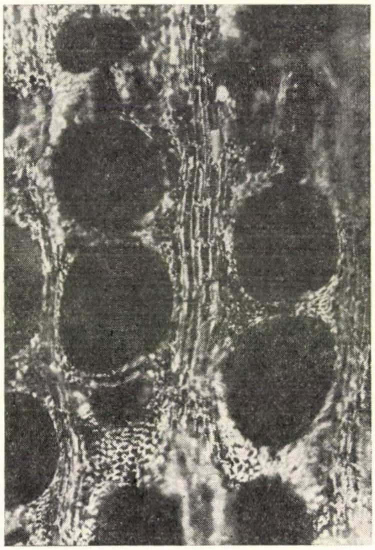

Fig. 1. Vitis sp. Cross fracture of fossile charcoal (72×)

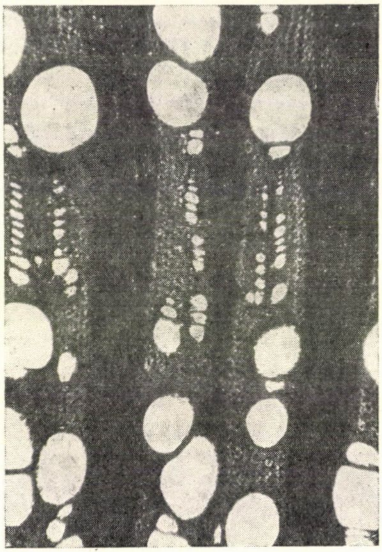

Fig. 2. Vitis vinifera cv *Furmint.* Recent wood cross-section (45×)

In southeastern Hungary traces of a settlement of the Bronze Age are known in the neighbourhood of the village Békés (90 m above sea level, alluvial meadow soil) (RADÓ 1967, STEFANOVITS 1956), where Prof. J. Banner carried out extensive excavations between 1950 and 1960. In the course of this work charcoal, wood-, seed- and crop remnants were found in considerable amount which Prof. Banner sent us with the purpose of biological studies. The material was examined mostly with the combined stereo-opaque microscope technique (STIEBER 1967). Of the several hundred pieces some proved to be remnants of grape; only these are dealt with in this paper. The remnants in question (labelled by Prof. Banner) are the following:

1.	1950/1	1 piece of decayed wood	25 mm
2.	1955/27	14 pieces of charcoal	5—25 mm
3.	1955/33	10 pieces of charcoal	5—10 mm

Sample 1. was found in a disturbed layer, while the other two in an intact one.

The pieces examined in three microscopic planes are of the same structure, so their major xylotomic features are given together (Fig. 1). In the cross-section big tracheae are apparent; in certain annual rings they form pore rings but in the early wood the largest trachea diameters are often found at some distance from the border of the annual ring rather than along the border. In late wood twin-pores and radial pores are also characteristic. The medullary rays are very wide (8—15 cells) and closely spaced (Figs 1, 5). The ground material consists primarily of fibres. The tracheae are perforated scalariformly, and it is very characteristic that the opposed bordered pits are horizontally elongated to such an extent as to go round the trachea, and by doing so they remind of a stair-like thickening (Fig. 3). For comparison Á. Hegedüs of the Research Institute for Viticulture sent us a wood sample of "Furmint" vine collected at Tarcal in 1963. Here again, we do not give a detailed account on the xylotomic examination of the sample, we only present pictures of longitudinal and cross-sections (Figs 2, 4).

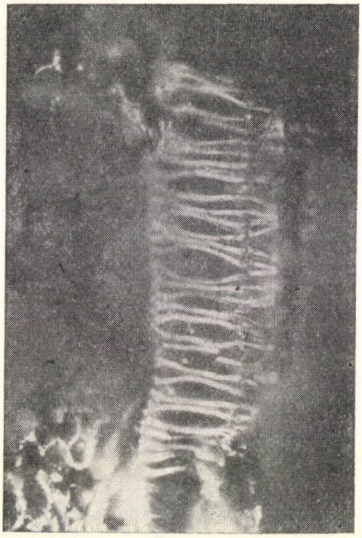

Fig. 3. Vitis sp. Tangential fracture of fossile charcoal. Part of a trachea with opposed bordered pits (460×)

From the briefly recited microscopic features it can be established that all samples are remnants of the genus *Vitis.* In the xylotomic determination we used the works by Brehmer, Greguss, Schmidt and Hegedüs (Brehmer 1928, Schmidt 1941, Greguss 1959, Hegedüs 1959, 1960, 1964, 1967, Hegedüs—Kozma—Németh 1966). Between *Vitis vinifera* and *V. silvestris* no certain xylotomic distinction has been made so far, therefore the species of the remnants cannot be determined. However, the importance of this question is controversial, as according to certain opinions *V. silvestris* is an escape of *V. vinifera.*

The above data are the first prehistoric of this kind in Hungary and prove that *Vitis* did occur here in the second millenaries B. C. Otherwise this region is today the poorest vine growing area of Hungary (Hegedüs—Kozma—Németh 1966, Radó 1967). In Hungary the oldest findings known so far are those of the Roman Age; both these and the later findings of the migration period (seeds from 10 sites altogether) were found in Trans-Danubia (Western

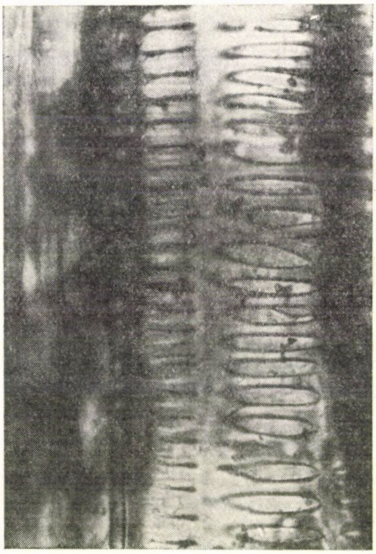

Fig. 4. Vitis vinifera cv *Furmint.* Recent wood tangential section. Part of a trachea with opposed pits (580×)

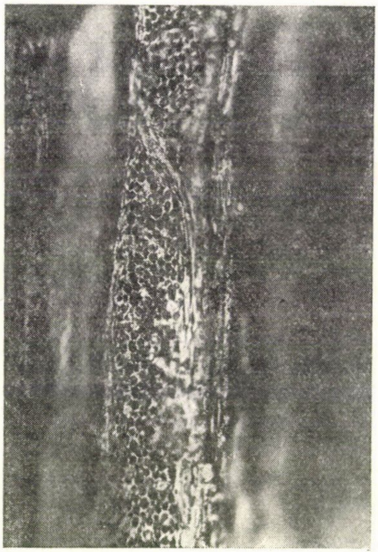

Fig. 5. Vitis sp. Tangential fracture of fossile charcoal. Medullary ray (110×)

Hungary) (Hartyányi—Nováki—Patay 1968). Excavations show that the initials of viticulture go back to the late neolithic period, primarily in Egypt. Most research workers dispute the existence of viticulture in the Bronze Age in Europe outside Greece, Italy and Southern France (cf. Buschan 1895, Neuweiler 1924, Lüdi 1954, Hegedüs—Kozma—Németh 1966). However, the fact that barley grains were also found at the site of excavation show the evidence of systematic plant growing. Thus, it is by no means improbable that our findings are remnants of cultivated vines.

Acknowledgement

We are indebted to Prof. J. Banner for placing the material at our disposal, to Prof. S. Sárkány, Head of Department for making possible and promoting our work and to I. Molnár, assistant, for performing the technical operations.

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GENETIC ANALYSIS AND BREEDING EVALUATION OF T. AESTIVUM L. × T. TURGIDUM L. HYBRIDS. I. COMPATIBILITY AND FERTILITY

The international literature includes several reports on crosses between *T. aestivum* and *T. turgidum* L. By combining these two species WATKINS (1928, 1932) and THOMPSON—ROBERTSON (1930) found a regularity, valid primarily for pentaploid hybrids, that poorer seed set but better germination of the hybrid grains occur when the parent with higher chromosome number (*T. aestivum* L.) is used as seed parent, while in reciprocal crosses higher seed setting percentage and poorer germination are obtained. The same conclusion was drawn by other authors too (KATAYAMA 1933, VENEDIKTOV 1958 etc.) — except GRANHALL (1943).

Present paper deals with the compatibility and fertility of *T. aestivum* L. (Eryth. 3201) × *T. turgidum* L. var. *linneanum* as well as of the back-crossed progenies of this hybrid. It has to be noted that crosses with other varieties of the same species are considered also back-crosses. Top-crossing is spoken of only when a third species too has a role in producing the hybrids.

Second pollination of the hybrids took place 12 hours after the first one, and was followed 8 hours later by a third pollination.

In our crossing program seed-set was poor in crosses between *T. aestivum* L. (Eryth. 3201) × *T. turgidum* L. var. *linneanum* (Table 1). On the other hand, hybrid grains germinated relatively well. WATKINS' earlier mentioned statement about seed-set and germination was true in this cross too.

The hybrid plants were back-crossed to various varieties of *T. aestivum* L. Seed-set percentage was found to have increased even in the first (15.3 per cent) but especially in the sec-

Table 1

Direct-, back- and top-crossing data of T aestivum L.×T. turgidum L.

Year	Combination	Number of pollinated flowers	Grains obtained	Seed set percentage	Germination percentage
1957	*T. aestivum×T. turgidum*	279	10	3.6	66.7
	reciprocal	460	43	9.3	22.8
1961	*(T. aest.×T. turg.)*×Mara	980	72	7.3	54.6
	×Etoile	576	88	15.3	49.7
	Total	1556	160	11.3	52.1
1962	*(T. aest.×T. turg.)*×Prod.×Bez.	2208	415	18.7	48.7
1964	*(T. aest.×T. turg.)*×Bezostaya	240	40	16.7	48.6
	(T. aest.×T. turg.)×F 293	360	89	24.7	52.7
	(T. aest.×T. turg.)×Produttore	1440	199	13.8	59.4
	(T. aest.×T. turg.)×Etoile	240	33	5.9	35.1
	(T. aest.×T. turg.)×Dobrovice	576	133	23.1	41.2
	(T. aest.×T. turg.)×Fortunato	360	57	15.8	33.7
	(T. aest.×T. turg.)×Norin 29	298	61	20.5	32.1
	Total	5070	772	15.3	43.2
1966	*(T. aest.×T. turg.)*×F 293 BC_2	696	246	35.3	56.9
	(T. aest.×T. turg.)×F 293×Bez.	1152	546	47.4	38.7
	(T. aest.×T. turg.)×Prod.×F 293	456	101	22.1	41.0
	(T. aest.×T. turg.)×Prod.×Bez.	636	330	51.6	29.2
	(T. aest.×T. turg.)×Prod.×Skoros.	240	87	36.5	45.0
	(T. aest.×T. turg.)×Prod.×Mir. 808	140	56	39.0	62.5
	(T. aest.×T. turg.)×Bez. BC_2	204	101	48.5	57.0
	(T. aest.×T. turg.)×Bez.×Orca	264	70	26.5	20.0
	(T. aest.×T. turg.)×Fort.×F 293	240	34	14.2	26.6
	(T. aest.×T. turg.)×Fort.×Bez.	192	78	40.6	24.4
	(T. aest.×T. turg.)×Norin 29×Bez.	300	71	23.7	48.0
	(T. aest.×T. turg.)×Etoile×Mir. 808	240	57	23.7	63.4
	(T. aest.×T. turg.)×Etoile×F 293	240	30	12.6	40.0
	(T. aest.×T. turg.)×Dobrovice×Bez.	216	18	8.4	55.4
	(T. aest.×T. turg.)×Dobrovice×F 293	288	132	46.0	36.4
	(T. aest.×T. turg.)×Dobrovice×Orca	552	192	34.9	44.0
	(T. aest.×T. turg.)×Dobrovice×Mir. 808	336	95	28.3	58.0
	Total	6396	2244	35.1	42.3
1966	*(T. aest.×T. turg.)*×T. aest. BC_3	840	255	30.3	78.7
1963	*(T. aest.×T. turg.)*×T. timoph.*	120	6	5.0	33.3
	(T. aest.×T. turg.)×T. timoph.**	120	7	5.8	42.8
	(T. aest.×T. turg.)×T. timoph.***	120	16	13.3	37.5
1963	*T. timoph.×(T. aest.×T. turg.)**	384	53	13.7	28.3
	*T. timoph.×(T. aest.×T. turg.)***	272	36	13.2	33.3
	*T. timoph.×(T. aest.×T. turg.)****	120	34	28.3	30.6

Signs used: * once, ** twice and *** three times pollinated flowers

Table 2

Fertility of direct-, back- and top-crossed F_1 hybrids of T. aestivum L.× T. turgidum L.

Year	Combination	N	Number of grains spike			Number of grains per spikelet	Thousand-grain-weight		
			$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	$\bar{x}$	s	s_x
1958	*T. aestivum× T. turgidum*	27	33.5	12.8	2.7	—	35.1	7.1	1.6
1962	*(T. aestivum× T. turg.)*								
	×Mara	56	53.9	18.6	2.2	2.8	36.3	8.4	2.1
	×Etoile	32	43.8	13.9	4.1	2.3	42.6	6.9	2.2
	×Glutinoso	16	32.0	11.6	2.7	1.8	40.2	7.6	3.1
	Mean		43.2			2.3	39.7		
1965	×Bezostaya	24	43.2	13.6	2.8	2.1	37.6	6.4	1.3
	×F 293	49	59.5	13.4	1.9	2.6	43.0	9.1	1.3
	×Produttore	67	53.9	18.1	2.2	2.3	35.8	6.4	0.8
	×Etoile	11	43.1	14.4	4.4	1.9	40.9	5.8	2.1
	×Dobrovice	73	53.6	11.8	1.4	2.2	32.2	7.0	0.8
	×Fortunato	27	52.8	14.8	2.9	2.3	32.6	9.1	1.8
	×Norin 29	16	51.0	20.8	8.7	2.3	43.3	7.5	3.1
	Mean		51.0			2.1	37.9		
1967	×F 293×Bez.	211	59.8	7.0	2.5	2.8	47.5	3.4	1.2
	×Bezostaya BC_2	86	58.1	6.2	2.2	2.9	48.6	4.6	1.7
	×F 293 BC_2	98	60.7	8.2	2.9	2.8	46.5	1.2	0.4
	×Prod.×F 293	41	65.3	2.7	0.9	3.1	46.3	2.3	0.8
	×Prod×Bez.	68	60.6	7.1	1.7	2.9	50.4	3.9	1.2
	×Prod×Skorosp.	39	78.5	12.9	3.7	3.7	47.9	4.3	0.1
	×Prod×Mironov.	35	68.1	8.8	1.6	2.9	45.5	3.0	0.7
	×Bez.×Orca	37	63.5	9.5	1.7	2.5	44.6	4.2	1.2
	×Fortunato×F 293	14	78.0	8.6	4.3	3.6	46.1	3.2	1.6
	×Fortunato×Bez.	19	56.8	4.3	1.9	2.6	56.2	—	—
	×Norin 29×Bez.	24	57.8	4.8	1.5	2.8	52.2	—	—
	×Etoile×Mir.	36	58.8	8.6	1.5	2.5	48.8	4.5	1.1
	×Etoile×F 293	12	68.3	24.7	7.1	2.8	47.2	4.2	1.4
	×Dobrovice×Bez.	10	84.3	6.1	3.0	3.7	49.5	2.6	0.2
	×Dobrovice×F 293	28	75.3	1.5	0.3	3.1	45.6	8.6	2.0
	×Dobrovice×Orca	84	66.9	12.5	4.4	2.7	40.2	—	—
	×Dobrovice×Mir.	55	63.2	16.5	3.6	2.6	45.4	3.5	1.2
	Mean		66.1			2.9	47.4		
	×T. aestivum BC_3	57	61.4	11.7	1.4	2.6	43.5	3.4	1.2
1964	*(T. aest.× T. turg.)× T. timoph.*	8	3.6	14.6	4.3	0.1	39.7	1.4	0.3
1964	*T. timoph.× (T. aest.× T. turg.)*	36	5.8	18.2	2.3	0.3	43.2	2.1	0.7

Table 3

Fertility and thousand-grain-weight of back-crossed F$_2$

Year	Combination	N	Number of grains		
			non-selected		
			$\bar{x}$	s	$s_{\bar{x}}$
1959	*T. aestivum* × F$_2$ *T. turgidum* F$_2$	53	49.8	6.1	1.8
1960	*T. aest.* × *T. turg.* F$_3$	28	53.9	3.2	0.9
1964	*T. aest.* × *T. turg.* F$_7$	18	55.9	3.1	0.9
	T. aest. × *T. turg.* F$_8$	41	70.0	4.6	1.5
	T. aest. × *T. turg.* F$_{10}$	30	81.4	4.7	1.8
1962	*(T. aest.* × *T. turg.)* × Mara	70	50.1	8.8	1.7
	(T. aest. × *T. turg)* × Etoile	30	44.0	4.6	1.1
	(T. aest. × *T. turg.)* × Glut.	55	57.7	5.4	1.6
	Mean		50.6		
1966	*(T. aest.* × *T. turg.)* × Bez.	120	72.5	9.6	2.4
	(T. aest. × *T. turg.)* × F 293	310	79.1	25.1	7.5
	(T. aest. × *T. turg.)* × Prod.	355	72.7	16.7	5.1
	(T. aest. × *T. turg.)* × Etoile	80	77.9	7.2	1.5
	(T. aest. × *T. turg.)* × Dobrov.	210	75.4	33.0	12.5
	(T. aest. × *T. turg.)* × Fort.	94	70.4	9.7	2.4
	(T. aest. × *T. turg.)* × Norin	22	88.8	8.5	2.1
	Mean		76.8		
1966	*(T. aest.* × *T. turg.)* × *T. aest.* BC$_2$	67	56.8	—	—
1967	*(T. aest.* × *T. turg.)* × Bez. F$_3$	150	62.3	7.1	1.6
	(T. aest. × *T. turg.)* × F 293	325	—	—	—
	(T. aest. × *T. turg.)* × Prod.	268	70.5	16.8	4.0
	(T. aest. × *T. turg.)* × Etoile	98	63.9	8.9	1.8
	(T. aest. × *T. turg.)* × Dobrov.	32	68.7	4.6	1.0
	(T. aest. × *T. turg.)* × Fort.	119	—	—	—
	Mean		66.3		
1967	*(T. aest.* × *T. turg.)* × *T. aest.* BC$_2$				

ond back-cross (35.1 per cent) as compared to direct crosses. In BC$_3$ the number of hybrid grains obtained was somewhat lower. Table 1 shows — among others — that the efficiency of seed-set depends to a great extent on the varieties used (5.9—24.7 per cent).

In the combination of *T. aestivum* L. × *T. turgidum* L. the number of hybrid grains obtained was lower when pollen of *T. timopheevi* Zhuk. (AG genom) with a genom character different from both parents had been carried to the stigma; while in reciprocal crosses more hybrid grains were produced.

A second, and especially a third pollination were more efficient than a single pollination as shown also by Table 1.

and F_3 hybrids of T. aestivum L. × T. turgidum L.

per spike			Number of grains per spikelet non-selected	Thousand-grain-weight					
selected				Non-selected			selected		
$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	$\bar{x}$	s	$s_{\bar{x}}$	$\bar{x}$	s	$s_{\bar{x}}$
—	—	—	2.2	34.6	5.8	1.4	—	—	—
—	—	—	2.5	35.8	3.4	1.3	—	—	—
—	—	—	2.3	34.8	3.8	1.5	—	—	—
—	—	—	3.2	37.9	5.1	1.4	—	—	—
—	—	—	2.9	35.8	3.1	0.8	—	—	—
—	—	—	2.5	40.8	5.4	2.1	—	—	—
—	—	—	2.3	39.7	5.2	2.0	—	—	—
—	—	—	3.1	38.9	4.8	1.9	—	—	—
			2.6	39.8					
54.3	14.5	4.4	2.9	38.6	3.4	1.0	48.0	2.8	0.5
61.1	8.6	2.2	3.4	38.4	4.2	1.3	43.6	4.9	1.6
61.0	24.2	7.3	2.9	38.1	2.8	0.6	44.6	3.1	0.7
61.4	9.5	2.4	3.1	41.5	3.3	1.3	41.5	2.9	0.6
48.2	8.7	2.2	3.0	34.9	5.2	2.1	40.3	5.4	2.2
69.5	15.7	4.7	2.9	37.2	5.2	1.4	42.8	3.8	0.9
54.0	7.6	2.4	3.6	43.4	2.4	0.5	45.8	2.5	0.5
58.5			3.1	38.8			43.8		
—	—	—	2.6	41.0	—	—	—	—	—
55.4	6.4	1.4	2.6	39.8	4.5	1.2	42.9	3.3	0.9
61.4	8.8	1.5	—	—	—	—	41.7	4.8	0.9
62.5	30.6	5.3	3.0	35.1	3.5	1.5	42.0	8.3	1.6
59.9	5.2	1.6	2.5	42.9	5.1	1.4	43.8	4.8	1.6
64.4	13.6	4.8	2.8	34.6	6.2	2.1	34.0	5.3	2.0
63.8	7.2	1.5	—	—	—	—	37.4	2.8	0.6
61.2			2.7	38.1			40.3		
61.4			—	—			43.5		

In our investigations high rate pollen sterility was observed in flowers of the F_1 progeny of the examined hybrid. In reciprocal crosses the number of sterile pollens was substantially lower (38.3 per cent). In this case too — similarly to the trend of seed-set and germination — higher pollen fertility was observed in tetraploid × hexaploid crosses than in reciprocal crosses. Pollen fertility of F_1 plants too was very divergent within this combination (extreme values of fertile pollens were 4.2—46.1 per cent).

In our study sterility proper is expressed — in accordance with the general practice — by the number of grains per spike, and number of grains per spikelet. In Table 2 F_1 hybrids of *T. aestivum* L. × *T. turgidum* L. are already of sufficient fertility.

In the course of several years' selection we succeeded in increasing substantially the average number of grains per ear. While in 1958 this value of F_1 plants was 33.5, average ear productivity of hybrids in the 10th generation of this combination was 81.4. Thousand-grain weight of progenies was — on the other hand — very low (34.6—37.9 g).

More or less differences were found in fertility (expressed by the above values) among back-crossed F_1 plants as shown by the standard deviation values in Table 2. An even greater difference can be observed in the fertility of F_1 hybrids as depending on varieties used. For example, in 1962 in the first generation of (*T. aestivum* L. × *T. turgidum* L.) × Glutinoso 32.0, while in crossing with the variety Mara 53.9 grains per ear were obtained.

It is also evident from Table 2 that grain number per ear of F_1 plants back-crossed to different varieties of *T. aestivum* L. decreased, while thousand-grain-weight increased as compared to direct crossing.

In second back-crosses — independently of whether they were crossed with the same variety or with another one — fertility of F_1 plants was improved, though they did not attain the average grain number per ear of *T. aestivum* L. × *T. turgidum* L. hybrids. In 1967 ear productivity in BC_2 was 66.1 and thousand-grain-weight 47.4 g. In third back-crosses both values were slightly lower (Table 2).

Highly sterile F_1 plants were obtained by top-crossing *T. timopheevi* Zhuk. to *T. aestivum* L. × *T. turgidum* L. hybrids (Table 2).

Fertility trend of F_2 and F_3 generations of back-crossed hybrid progenies was also followed. Majority of the combinations of these generations also showed the effect of selecting for a higher thousand-grain-weight which involved, to some extent, a decrease in the number of grains per ear. Table 3 shows that thousand-grain-weight of selected F_2 hybrids increased by 12.9 per cent (43.8 g) compared to that of non-selected plants (38.8 g). On the other hand, the number of grains per ear decreased by 23.8 per cent in the examined hybrids. Similar phenomenon can be observed — according to Table 3 — in the F_3 generation, where in the combinations thousand-grain-weight increased by an average of 5.8 per cent, while the number of grains per ear was proportionally lower (7.7 per cent).

*

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CYTOLOGICAL OBSERVATIONS ON THE COTYLEDON OF THE GERMINATING SUNFLOWER

For the time being, the processes taking place at the accumulation of nutritive substances and at the decomposition of the stored matters in the cells of the storing organs and tissues are not adequately known from structural point of view. In recent years several works have treated the question in its ultrastructural aspect too (ENGELBRECHT—WEIER 1967). Observations on the accumulation of nutritive substances have been carried out in connection with analyses on the organization of ricinus and poppy seed (SÁRKÁNY 1964, GRACZA—SÁRKÁNY 1967).

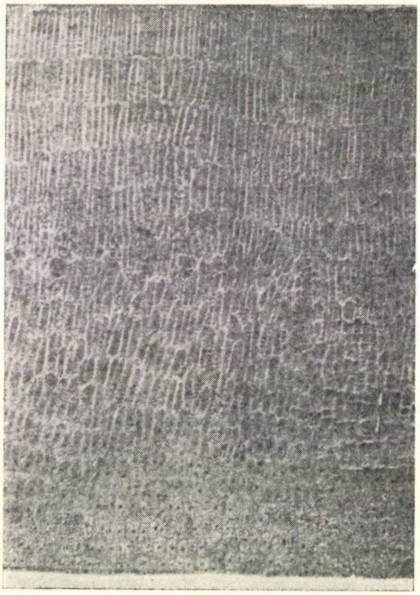

Fig. 1. Cotyledon cross-section. Under the upper epidermis 4—5 cellrows of palisade parenchyma, several layers of compact spongy parenchyma, then the lower epidermis. (Obj. 6.3, oc. 4×)

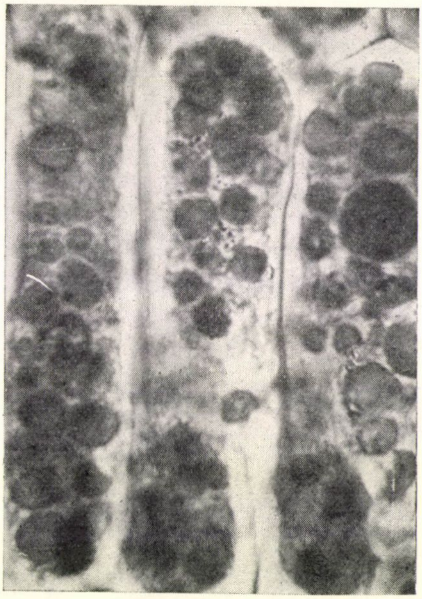

Fig. 2. Palisade parenchyma tissue fraction of the cotyledon. (Obj. 40×, oc. 5×)

The present paper intends to give a short description of observations, mainly of cytological character, on the cotyledon of the germinating sunflower, carried out partly with light microscopic and partly with electron microscopic method, comparing them with the results of simultaneous chemical tests. The choice of the object was motivated, among others, by the fact that the cotyledons of the *Aster*-type embryo of the sunflower (CARANO 1915), which contain in state of dormancy 44—55 per cent of fatty oil and 24—30 per cent of protein (JÁKI—JÓNAP 1957), undergo a functional change during germination: by gradually losing the function of storage they turn into assimilating leaves.

The present work was started at the state of dormancy of the seed, and was continued till the six day-stage when the height was 8—10 cm. Colourless at the beginning and turning green later on, the cotyledons were fixed in Bouin's solution for light microscopic investigations and in 2 per cent buffered potassium permanganate for electron microscopic purposes; they were embedded in paraffine and araldit, respectively, and the microtome and ultra-microtome sections were examined with an electron microscope type KEM 1.

According to light microscopic observations the mesophyllum of the cotyledon of the embryo at dormancy consists of 3—4 layers of palisade parenchyma from the side of the upper epidermis, and of 6—8 cell rows of a tissue corresponding to spongy parenchyma in regard to its position, from the side of the lower epidermis. It is characteristic of the latter that its cells stick closely together, without any conspicuous intercellulars (Fig. 1). Reserve protein is stored in the mesophyllum cells in form of large-sized aleuron granules. There are furthermore finely distributed fatty oil drops to be found in the cytoplasm (Fig. 2).

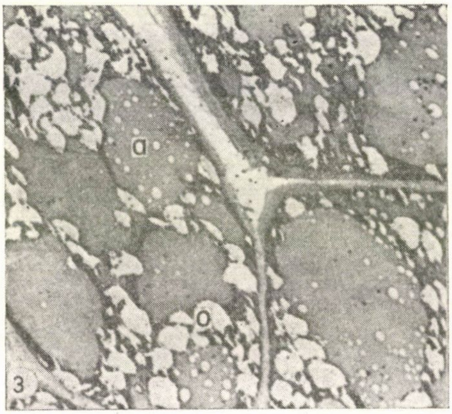

Fig. 3. Electron microscopic part of resting cotyledon. Major aleuron bodies (a) and smaller oil drops (0) in the cells. (6000×)

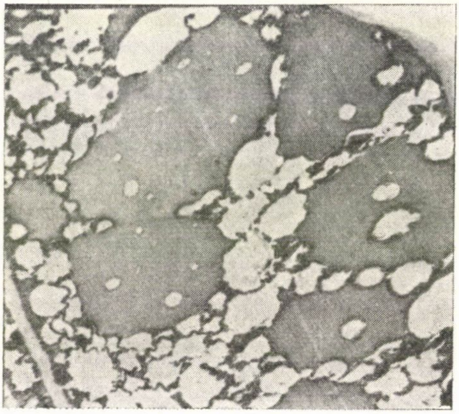

Fig. 4. 9—45 hours after germination the aleuron bodies begin to dissolve (6000×)

Most of the cytological changes occurring during germination take place on the ultrastructural level, therefore material was fixed for electron microscopic investigation and processed 1, 9 and 15 hours, and then 2, 4 and 6 days after swelling. The ultra-structural conditions and changes can be outlined as follows: According to the ultra-structural picture, the cells of the cotyledon are more or less still in dormancy after 1 hour of swelling. The still gelatinous cytoplasm is restricted to a very small volume, without any organels to be recognized. The major part of the cell lumen is filled out with large aleuron granules and smaller fatty oil corpuscles (Fig. 3).

The intensification of activation processes within the cells is indicated by the fact that 9 and 15 hours, and 2 days after swelling the aleuron granules in the fixed material are not intact any more, but have corrosions of various size on their border (Fig. 4). At the same time, the increase in water content of the cytoplasm (its solification) is indicated by an increase in the cytoplasm quantity and in the space it occupies, mainly along the cell walls. Some fragments of the membrane system of the endoplasmatic reticle and, among other cytoplasm organels, proplasts and mitochondriums are appearing simultaneously, most scarcely at the beginning (Fig. 5). It is interesting and not easy to explain that the proplasts are more numerous than the mitochondriums although we are faced with a cell, or a state, where dissimilation is prevailing. Furthermore, the electron microscopic structure leads to the conclusion that the mobilization of the fatty oil bodies could not yet have started to a large extent.

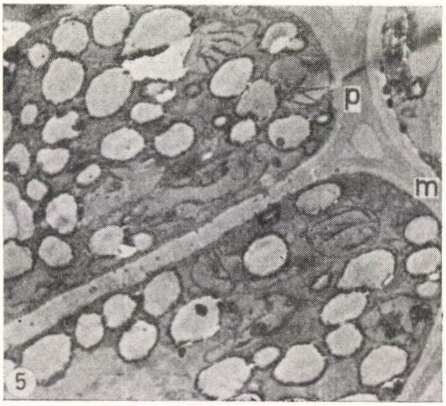

Fig. 5. Proplasts (p) and mitochondriums (m) begin to appear in the cells (6000×)

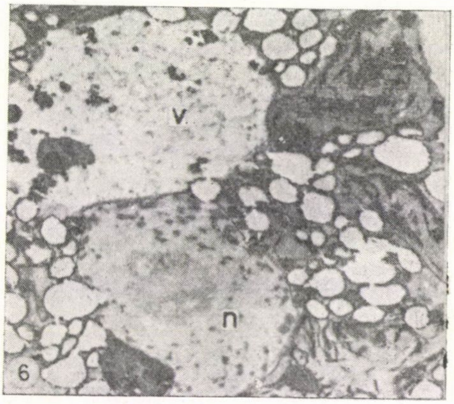

Fig. 6. Owing to the dissolution of the ale uron bodies a central vacuole (v) is formed n = nucleus. (6000×)

Fig. 7. Prolamellar bodies (pr) appear in the growing proplasts (9000×)

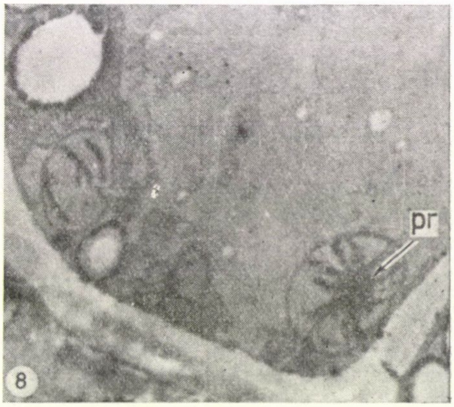

Fig. 8. Prolamellar bodies (pr) appear in the growing proplasts (9000×)

Beginning with the 4th day after swelling, the aleuron bodies are mostly decomposed and a large central vacuole is formed at the same time (Fig. 6). There is thus a process taking place in the cells of the cotyledon, opposite to that of the seed formation, when, as a result of gradual dehydration, the central vacuole is divided into more and smaller vacuoles. As germination proceedes, the intensive increase in plasm goes on, a wide plasm hose is developing next to the cell wall, still containing many fatty oil vacuoles. According to the chemical analysis the fatty oil content of the cotyledon of the 4 day-old seedling decreases from the original 55 per cent to 50 per cent. It is characteristic of the ultra-structural picture that the proplasts become considerably larger, and a prolamellar body is developing in their interior, while lamellae are subsequently growing out of it (Figs 7 and 8). The differentiation of the chloroplasts begins at the 4th day of germination. The former statement still holds true that the plasm is very poor in mitochondriums although oxidative decomposition processes take place in the cells. Together with the activation of the plasm, the plasmodesms, passing through the cell

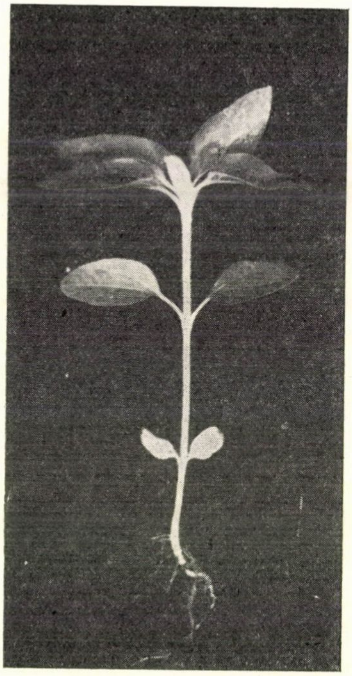

Fig. 9. Green cotyledons are assimilating on 20—30 cm seedlings

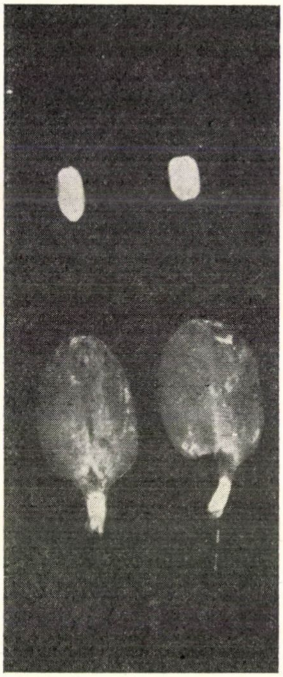

Fig. 10. Cotyledons in dormancy (above) in fully developed green state (below)

walls and still thin when the seed is in dormancy, grow thicker and thus intensify the intercellular contact.

After the 6th day the decomposition of fatty oil becomes more intense, as shown by the smaller number of fatty oil drops and by the results of the chemical analysis. By this time the fatty oil content decreases to 35 per cent. Simultaneously with the decomposition of the nutritive substances stored in the cotyledons, the latter turn gradually green after the 4th day, they open and spread out. Due to the differentiation processes taking place in the growing proplasts, the new function of the cotyledons, carbon assimilation, comes to the front. As an external morphological manifestation thereof the cotyledons grow vigorously as compared to their original volume. The importance of the role of cotyledons in the assimilation is shown by the fact that they are still present on seedlings with 20—30 cm height. The changing function of the cotyledon represents not only the changing of cytological conditions, but is also incident to histological tarnsformation. This is shown by the structure of the fully developed cotyledon. Grown to 4—6-times larger than its original size, the cotyledon did not increase in thickness, although the volume of the cells has increased. This may be explained with the decreasing number of the cells building up the leaf, and this, in turn, is due to the interpenetration of the cell layers (Figs 9, 10, 11).

To sum up it can be stated that among the nutritive substances stored in the cotyledon of the sunflower it is the protein which is first decomposed; simultaneously an intensive increase in cytoplasm and propast formation begins, followed by assimilation. This assimilation is accompanied by the intensified mobilization of fatty oil, continuing during the differentiation of chloroplasts.

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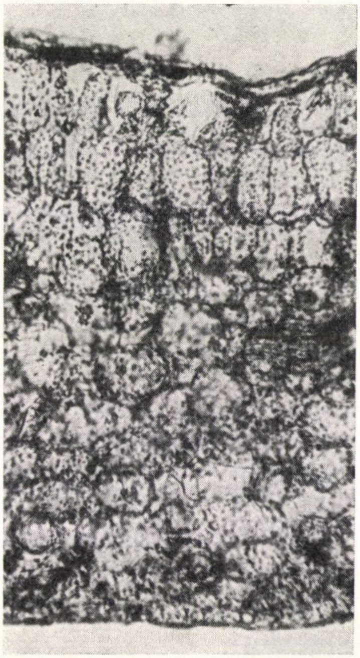

Fig. 11. Cross-section of the green cotyledon (Obj. 6.3×, oc. 4×)

Prepared at the Institute for Applied Botany and Histogenesis, Loránd Eötvös University, Budapest

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TAXONOMY OF HUNGARIAN CULTIVATED HOPS

Hop varieties are few in number. As cultivated varieties var. *acrocarpus*, var. *effusus* and var. *spaltensis* were described earlier by ALEFELD (1866). Var. *acrocarpus* has small, round, compact, light coloured cones which are especially closely spaced at the ends of shoots. Var.

effusus has oblong cones scattered along the laterals of the upper half of the stem. Cones of var. *spaltensis* are large, oblong, four-edged, situated mostly one by one on the laterals which are of similar position to that described above.

The name of ALEFELD's wild hop: var. *silvestris* is a synonym as it refers to the plant described by LINNÉ. According to the nomenclature internationally accepted in Stockholm (1950) wild hop as a type should be referred to as var. *lupulus* — without any authors.

Descriptions by ALEFELD on cultivated hop varieties are incomplete. No measurements and phenological data are given, the colour of shoots is not spoken of either, therefore they cannot be compared with presently cultivated hop varieties. Var. *spaltensis* belongs certainly to the variety group Saazi.

Accordingly, wild hop (var. *lupulus*) is distinguished as a type, the cultivated varieties with divided leaves can be grouped under the name convar. *europaeus* MÁNDY, while hops with entire, heart-shaped leaves grown in East-Asia can be called convar. *cordifolius* (Miq.) MAXIM (syn.: *Humulus cordifolius* Miq.).

Hops cannot be spoken of as varieties in a sense generally accepted in plant growing. Hop varieties are essentially clones, i.e. consists of a succession of generations produced for centuries with vegetative propagation and possessing identical genetic material. The relatively constant characteristics of the individual varieties can be explained by this fact. Varieties produced from different source materials, thus possessing more or less different characteristics, were distributed from more than one centres of cultivation in Europe. Under the influence of local factors acting through centuries these varieties have been displaying further alterations, however, they can usually be determined by considering their origin.

FRUWIRTH (1928) mentions 50 registered varieties. They differ from one another in length, shape and tip of bract, and length, width and compactness of cones.

By the colour of shoots and rhythm of development hop varieties are divided into three groups:

I. Red hops (provar. *purpurascens* SIMON; Diagnosis: cormus et gemmae praevernales coloris fuscae purpurascentis. Praecoces et mediocriter praecoces. Fructus generatim diebus 14 antea, quam illi humulorum viridescentium, que ordinatim in Septembrem maturescere solent decerpi possunt. Juli oviformes vel oblonges, relative clausi. Circa medium Julium (inter dies 10—20.) florent. Exempli holotyporum in Instituto Phytosystematico-Geobotanico Universitatis Budapestini sunt.). Their name derives from the reddish brown colour of shoots and early spring buds. Early and medium-early varieties, cones can generally be harvested 14 days earlier than those of green hops which usually mature by September. Their cones are oval, or oblong oval, relatively closed. They develop flowers in mid-July or so (10—20.).

From an economic point of view red hops have the following excellent characteristics: relatively closed cones, abundant lupulin content, good or excellent odour. Their high quality is proved by the fact that in Central Europe almost exclusively hops belonging to this group are grown. Some of them are the following:

1. 'Medium early Hellertau' (Hungarian = 'Középkorai hellertaui'; cultivar). Vigorous hops with few leaves, medium long curving laterals and a great number of compact. odorous cones rich in lupulin. Bracts of cones are oblong lanceolate, acuminate. They are susceptible to peronospora but resistant to aphides.

2. 'Saaz' (Hungarian =' Saazi') variety group (concula). This group partly includes related hops, partly those of different origins but very close to one another concerning their characteristics. Among them Semsch-hop is widely grown in Saaz (northern Czechoslovakia). It possesses the favourable characteristics of 'Saaz' hops (Fig. 1.1.), has relatively few but high-quality cones with abundant lupulin of very pleasant odour. Foliage is dense, laterals less outstanding, bracts of cones short, acuminate. Susceptible to aphides and two-eyed mites, resistant to peronospora. Hops with similar characteristics belonging to the variety group 'Saaz'

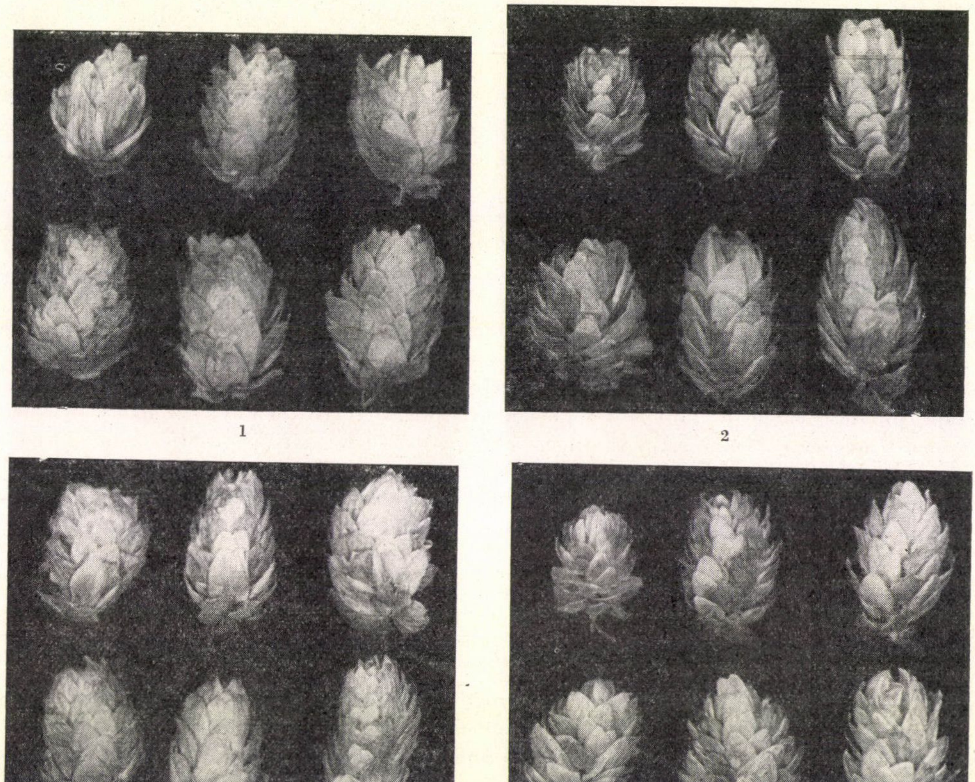

Fig. 1. Cones of the major hop varieties grown in Hungary. 1. 'Saazi'. 2. 'Elszászi'. 3. 'Soviet'. 4. 'Mezőhegyesi'. 5. 'Württembergi'. 6. 'Bácskai' (Photos by T. Simon)

are: 'Auschi kései vörös', 'Középkorai- és 'Korai spalti', 'Tettnangi korai', 'Stájer' and 'Galiciai'.

3. 'Golding' (cultivar). Similar to those belonging to the 'Saaz' group but with a greater number of cones; with their high content of odorous lupulin they have the widest application in England.

4. 'Soviet' (Hungarian = 'szovjet') (cultivar, Fig. 1.3.). They are similar to those belonging to the variety group 'Saaz' but have lower requirements. Cones are relatively large, compact, roundish egg-shaped, cylindrical; bracts are relatively large (14—20×8—15 mm), spatulate with narrowing shoulders and short, sharp tips. Lupulin content is sufficiently high, its quality is nearly the same as in the 'Saaz' group. Medium early varieties.

II. Green hops (provar. *viridescens* SIMON; Diagnosis: cormi gemmaeque viridescentes. Differunt a Humulis purpurascentibus foliis maioribus et longioribus petiolis et jules laxiores atque asperiores. Omnes sero maturescentes, in Septembri maturitatem decerpendi attingentes. Lupulin leniter purpurascens, odorem habet parum jucundum, saepe odori Alii sativi similem, annis pluviosis etiam foetidum. Exempli holotyporum in Instituto Phytosystematico-Geobotanico Universitatis Budapestini sunt.). Shoots and buds are green. They differ from red hops also in having larger leaves with longer petioles, looser and rougher cones. All are late varieties attaining harvesting maturity in September. Lupulin is of slightly reddish colour, its odour is less pleasant, often garlic-like, in humid seasons may even be stinking.

Besides their poorer quality green hops have very high yields and lower demands on growing conditions. They are grown mainly in North-America and Western Europe, in Central Europe their importance is lesser. Their representative here are: 'Württembergi kései' (Fig. 1.5), 'Hersbrucki kései', 'Elszászi' (Fig. 1. 2), 'Daubai zöld' and 'Bácskai' (Fig. 1. 6) grown also in Hungary.

III. Whitish green hops (Provar. *albo-viridis* SIMON; Diagnosis: medium tenet locum inter greges duas supra descriptas. Color quidem cormi et folia similia sunt cormo et folii Humulorum purpurascentium, julus vero julo Humulorum viridescentium. Exempli holotyporum in Instituto Phytosystematico-Geobotanico Universitatis Budapestini sunt.). They form an intermediate group between the two former ones. Colour of shoots and foliage resembles those of the red hop while the cones are similar to those of the green hop.

Taxonomic key to major Hungarian hops.

1 a) Leaves and cones are large. Cone axis considerably divided (4—7 branches in 1 cm). Cultivated hops .... 2.
b) Leaves and cones are smaller (in f. *brachystachyus* (ZAPAL.) 10—25 mm long). Cone axis less divided (3—4 branchings in 1 cm). Wild hops (var. *silvestris* Alef. 1866, var. *europaeus* MÁNDY p.p. 1951) var. *lupulus* ....
2 a) Leaf blades divided (convar. *europaeus* MÁNDY p.p.) .... 3.
b) Leaves entire, heart-shaped convar. *cordifolius* (MIQ.) MAXIM. ....
3 a) Shoots and early spring buds reddish, cones relatively closed, compact, pleasantly odorous. Mostly early and medium early varieties. Red hops (provar. *purpurascens* SIMON) .... 4.
b) Shoots and buds green, leaves larger, with long petioles. Cones of relatively loose structure, strong (often garlic-like) smell. Late varieties (ripen in September). Green hops (provar. *viridescens* SIMON) .... 5.
4 a) Cones medium large (cca. 25—35×17—28 mm), brachts relatively large (cca. 10—21×4—11 mm), with short, sharp tips, cone axis highly divided (6—7 branchings in 1 cm). Odour very fine. Pistilled flowers are evenly distributed, though below often decrease in number. They ripen early ....
conculta 'Saazi' (variety group) (Fig. 1.1) ....
b) Cones about 26—40×21—25 mm large, bracts relatively large, wide (cca. 16—20×

8—15 mm), with short sharp tips. Cone axis moderately divided (5—6 branchings in 1 cm). Pleasant odour, medium late ripening ....
cv. 'Soviet' (Fig. 1.3) ....

5 a) Cones large (cca. 26—42 × 16—26 mm), bracts relatively large (cca. 15—21 × 7—12 mm), with long (—2 mm) suddenly sharpening tips. Cone axis moderately divided (5—6 branchings in 1 cm). Strong, garlic-like odour, which disappears during storage. Late ripening ....
cv. 'Elszászi' (Fig. 1.2) ....

b) Cones medium large (cca. 24—38 × 19—28 mm), bracts smaller (cca. 7—18 × 4—9 mm) .... 6.

6 a) Cones about 24—38 × 19—25 mm large, bracts medium large (cca. 11—18 × 7—9 mm), with suddenly sharpening tips, cone axis moderately divided (5 branches in 1 cm). Pleasant odour, late ripening ....
cv. 'Württembergi' (Fig. 1.5) ....

b) Cones cca. 28—47 × 21—28 mm large, bracts relatively smaller (cca. 7—17 × 4—9 mm) with short sharp tips. Cone axis moderately divided (5—7 branches in 1 cm). Pleasant, sometimes pungent odour, late ripening cv. 'Bácskai' (Fig. 1.6) ....

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THE DEVELOPMENT OF THE PISTIL IN LIGUSTRUM VULGARE L.

Investigations have been carried out for two years in our Institute on the development of the pistil in various species of the *Oleaceae* (Gracza 1966, 1967). Previously, and particularly as far as flower organisation of *Ligustrum* was concerned, the publications were rather short and of general character (van Tieghem 1871, Velenovsky 1910, Weber 1928). The present paper is dealing with the developmental process of the pistil in *Ligustrum vulgare L.*, taking into account the development of the vascular tissue system.

Developing buds and flowers of *Ligustrum vulgare* have been gathered in two periods. The first period included the time from gemmation to efflorescence (March 20—May 30), and the second one did so with the different phases of development (July 1—October 10), at 20 occasions. The test material submitted to the usual microtechnical procedure was embedded into paraffine, and microtomic sections were made. The vascular tissue system was studied on flowers prepared with clarification.

In the apical mixed buds of shoots the initial vegetative cone of the bud becomes reproductive in August, while in autumn double umbrels grow at the end of the ramifications of the small primordial inflorescence. Due to the divisions taking place in the subprotodermal layer at the marginal part of the flat broad flower primordia, four sepal primordia appear along the median and transversal plane. Further divisions continuing in a centripetal sense in the subprotoderm of the flower primordium produce four petal primordia in the diagonal plane. After having reached a height of 4—5 cell rows the petal primordia grow together at their basal part, as a result of latitudinal increase due to the function of submarginal initials, and form a united ring of primordia. For a while, the stamen primordia growing along the transversal plane are increasing freely, then grow together at their basal part outwards with the petal primordia and inwards with the pistil primordia developed in the median plane. In this stage, the developing small pistil primordium — consisting for the moment only of the hollow ovary — is surrounded by congenitally interlaced tissues of stamen and petal primordia and, to a certain extent, by sepal primordia as well, so that the ovary primordium can be observed sunken in seemingly low position, while the released parts of the sepal, petal and stamen primordia bend out towards the ovary primordium (Fig. 1, 2).

Fig. 1. Flower primordium of *Ligustrum vulgare* L. with calyx, petal and stamen primordia. (obj. 20×, oc. 5×)

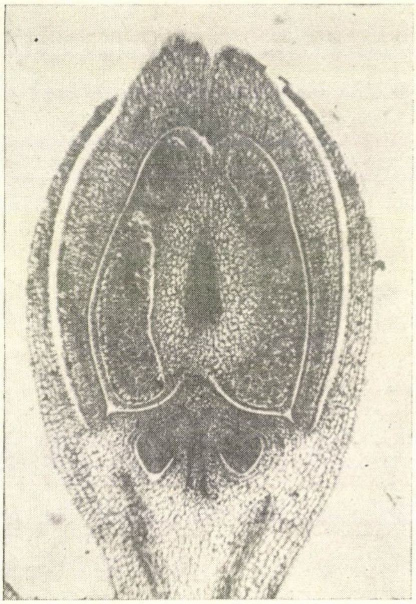

Fig. 2. Young buddy stage: the ovary of the pistil primordium seemingly low-positioned. (Obj. 10×, oc. 5×)

In the spring to follow, the small flower primordia begin to develop intensely in the course of budding. In the apical parts the growth of the young petal, sepal and stamen leaves takes place with cell divisions, and on the basal parts with cell elongation.

Cell elongation is terminated first at the basal part of these organs. Meanwhile, the growing and converging carpel primordia develop the style part. At the same time, intensive cell division continues in the tissue of the ovary primordium, partly in the lateral walls of the ovary and partly in the tissue region below, as a result of which the young ovary emerges gradually from its original position, gets elongated and temporarily assumes a mid-position. Due to the cell elongation replacing cell divisions, the pistil continues to rise so that, at the time of efflorescence, the calyx and the petals as well as the stamina grown on the petal tube spring from under the pistil, so that by the end of development, the seemingly low-positioned pistil primordium will have become typically high-positioned. Cake-shaped at the beginning, the ovary, due to volume increase, assumes gradually and inverse conical shape.

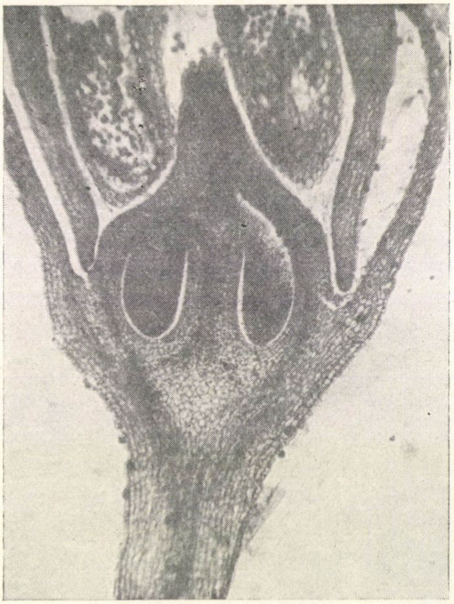

Fig. 3. In somewhat older buddy stage the young ovary already in mid-position. The ramifications of the vascular bundles prove the congenital adherence of the basal parts of the calyxthe petal and the stamen. (Obj. 10×, oc. 5×)

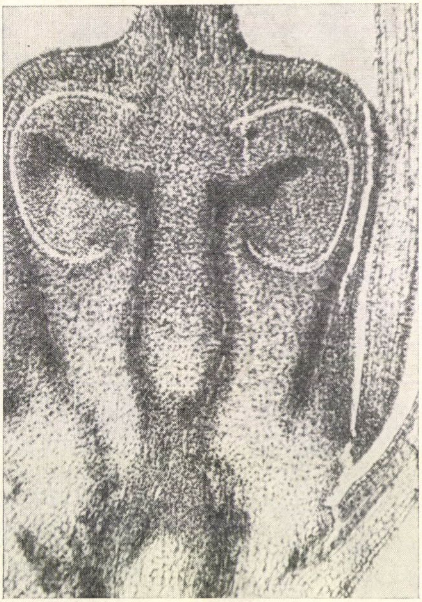

Fig. 4. In open flower stage: typically high-positioned pistil. (Obj. 0×, oc. 5×)

The procambial network of the flower develops early. Simultaneously with the development of the pistil primordia the bundles of the receptacle also appear, with ramifications under the hollow of the ovary primordium, thereby supporting the basal adherence of the calyx, the petal and the stamen, as well as the seemingly low-positioned character of the pistil primordium. Later on, this congenitally interlaced basal tissue region gets but slightly elongated, thus the ramifications of the vascular bundles differentiating gradually from the procambium remain in this level, or get only slightly higher than the ovary of the fully developed pistil (Fig. 3, 4).

Though different in shape from the pistil of *Syringa vulgaris*, that of *Ligustrum vulgare* takes much the same progress of development and can thus regarded as a transitional type between seemingly low-positioned and typically high-positioned pistils.

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WINTER WHEAT BÁNKUTI 1201

(Bánkuti 1201 őszi búza)

Taxonomic place: Triticum aestivum L. var. *erythrospermum* (Körn.) Msf.

Origin: A crossing of Bánkúti 5 selected from a local variety of the Tisza-district and of Marquis wheat.

Beginning of breeding: 1921, Bánkút.

Breeder: László Baross, Bánkút, State Farm.

State qualification: State registered improved variety, 1931, 1951.

General characterization: Winter-hardy, dry-resistant early variety, liable to lodging and maturing uniformly; it is an awned winter wheat with red grains producing steady, however, medium yield and having good flour-quality. It is a standard Hungarian variety.

Morphological description:

Root system: It penetrates into soil as deep as about 110 cm; 68 per cent of the root system is in the upper 10 cm of the cultivated layer, while 20 cm below it only 20 per cent of the root can be found (Mrs. KÁRPÁTY—MÁNDY 1961).

Shoot system: vigorous development, rather moderate tillering, especially when it occurs in spring (late sowing); its value is max. 2.7.

Straw: average 111 cm (range: 90—123), it is thin and liable to lodging; at the time of maturity the elastic straw is yellowish white.

Foliage: the leaves of the young plant are medium broad, greyish-green and bending backwards; the leaf-blade is linear lanciform and waxy; the auricle is light straw-yellow; susceptible to leaf-rust, however, due to its quick development, a serious infection is often eluded (PAPP 1954).

Ear: awned, fusiform, average length is 7.8 cm (ranging from 6.8 to 8.7 cm). At the time of maturity it is yellowish-white. The mature ear is drooping and of mediocre fullness; in the spikelets generally 2—3 grains develop; scattering (loss) of grains averages under 1 per cent; the weight of grains in the ear is 0.7 g (ranging from 0.5 to 0.9); in normal sowing the number of ears per m^2 is, on the average, 403 (ranging from 321 to 451). The awn is long and rough, the spikelets are closed, the glume is short-awned, shouldered, ellyptical. At the time of maturity the ears are generally in the same height.

Caryopsis: elongated ovate, 4.1—7.5 mm long and 2—4 mm wide. The scutellum is round, the embryo vigorous. The grain is red (brownish), its substance hard, flinty. Thousand grain weight is 37.9 g on the average (ranging from 32 to 43.4 g), hectolitre weight is 81 kg (ranging from 79 to 84 kg). Flour quality is good (B_1—A_2), wet and dry aleuron contents are 35—47 and 11—13 per cent respectively.

Biological characters:

Germination: cardinal points minimum +2 °C, optimum 15 °C, maximum 35 °C. Germination period in optimum is 4.6 days (MÁNDY 1961).

Vegetative period: from seeding to ripening on the average 264 days (ranging from 250 to 272 days).

Development: rapid and vigorous, early earing. During development its warmth-requirement is higher than that of other extensive Hungarian varieties (PAPP 1954).

Winter hardiness: good-, sensitive to frost.

Resistance to diseases: very susceptible to powdery mildew; to rust diseases it is pseudo-resistant, since, due to its quick development, it escapes the period of intensive infection (KAPÁS *et al* 1965, PAPP 1954).

Farm technology requirement:

Seeding: medium early sowing is required, i.e. first half of October (MÁNDY 1967). Seed requirement 3.1—3.3 million germs/cad. yoke (540—560 germs/sq.m.).

Soil requirement: except on dry, alkali and rigorously sited soils it gives rich yield when soils are well cultivated (PAPP 1954).

Productivity: long-term average yield is 15,6 q/kh (kh = 1 cad. "hold" = 5754.56 m^2 = 1422 acres) (ranging from 11.1 to 18.9 q/kh); straw yield on the average 32.6 q/kh (ranging from 22 to 24 q/kh).

Area of cultivation: Can be successfully grown in all wheat growing regions of Hungary.

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FORUM

COMMENTARY

on the book "Autumnization and its Genetic Interpretation" by S. Rajki

In the preface of S. Rajki's book edited in Budapest in 1967 we can read as follows: "When selecting the experimental data characteristic of the entire experiment and required by the proof I attempted to save the reader's time, for, due to the tremendous growth of information in research today, time is tightly evaluated much more highly than money". In my opinion the argumentation given by the author is erroneous. Who writes a book about fundamentally new establishments concerning the whole molecular biology, the accepted evolution-genetical theories and the employed thremmatology, does not save the reader's time by leaving out from his book details which are indispensable data in the aspect of evidence. It is not an assistance to the reader to get an invitation of looking after the data left out, in Rajki's numerous papers published in various periodicals at different times.

In the meantime several reviews have been published in different periodicals. These critical manifestations have induced me to reveal details which, in my opinion, challenge the validity of the author's statements. In every case I refer to Rajki's own data described in any of his papers.

Rajki wished to prove with a series of experiments over more than ten years that a wheat strain, homozygous in spring habit, may be transformed into real winter wheat by means of repeated autumn sowings. If his efforts are successful, the experiment proves that environmental factors are capable of influencing through the soma the DNA to alter in the desirable direction and the new property becomes hereditary. The experiments were repeated three times, in 1955, 1957 and 1962.

Assumption of the inheritance of acquired properties derives from the ancient times. We can follow this concept from Anaxagoras to Lamarc in the course of development of biology but when experimental biology proved the existence of pure lines this assumption fell. Numerous attempts were made in the 20th century to make the problem clear and determine the right direction, but the fact of the inherited adequate adaptation has failed to be proved. When somebody wishes to solve such a fundamental problem, knowing the earlier failure, has to learn very well the necessary requirements important to the reliability of such an experiment, and must keep them with extreme care (RAJKI 1962c[1], DIONIGI 1958, STUBBE 1955).

The essential requirements are as follows:

a) It is indispensably necessary to prove *in advance that the property, planned to be changed, was in homozygous stage at the beginning of the experiment.* If it was not proved the result of the experiment is inacceptable, because in case of heterozygosy there may secregate such types in the offsprings which can have the appearance of the wished change.

b) The possibility of gene inmigration must be excluded. *This requires correct isola-*

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[1] p. 63. lines 15–35 and p. 64. lines 1–23.

tion long before and during the whole experiment. Without it the spontaneous crossings may lead to combinations which agree with the expected result.

c) The knowledge of the frequency of spontaneous mutation for the examined property is important. *Frequency of the change induced on the effect of the examined environmental factor must surpass statistically the above mentioned value.* If the data do not prove this fact it is possible that spontaneous mutations occurred which can easily be confused with the change in the direction of the examined effect.

d) If a. and b. of the aforementioned conditions are not realizable undoubtedly, selection pressure also damages authenticity of the experimental results (STUBBE 1955). It is not allowable to the modified conditions to affect as selecting factors.

The terms are very rigourous but without them the confidence of the experiment will be destroyed. When somebody wishes to confute fundamental establisments of theoretical biology, he has to consider these rigourous restrictions.

To ensure the first condition, i.e. homozygous stage, is difficult with higher plants. Allohexaploid wheat is less suitable for this purpose. In the case of autumn character it is difficult to imagine the homozygous stage, as, according to the monosomic analyses, this property is located at three pairs of chromosomes (MORRISON 1960, HALLORAN—BOYDEL 1967) and there are loci in other chromosomes too, which influence the mentioned property. Therefore it is a legal assumption that a polyfactorial property really reaches the monozygous stage only after *7—8 undoubtedly self-fertilized, isolated, controlled and selected generations.* Otherwise, it is not out of question that on the effect of selection pressure very different offsprings may segregate in a large population, especially when such properties are concerned which are not recognizable through their morphology, so they cannot be selected easily before the beginning of the experiment.

Rajki knew well all the difficulties, nevertheless, he chose as experimental object wheat varieties belonging to the hexaploid group. So it is badly needful to discuss the arguments given by the author to prove the results of the experiments. On the basis of his published works we can summarize as follows:

1. At the starting of the experiments in 1955 S. RAJKI used seeds collected with his own hands (RAJKI 1967[2]) at the Biological Garden of the Timirjazev Agricultural Academy in Moscow. This means that he omitted the preventive severe isolation and selection. During the three experimental years the ears were not isolated, though in every year there were winter wheat stands quite close to the experimental field (RAJKI 1960,[3] 1962a,[4] 1966[5]). Each year half portion of the collected seeds was sown in autumn and the rest in spring. So one part of the population was under permanent selection pressure (RAJKI 1962a[6]).

2. The starting material of the experiment in 1957 derived from strains used in the earlier period (RAJKI 1962a[7]). This experimental series also disregarded the isolation in spite of the near winter wheat stand. The selection pressure was the same as in the former cycle, the result agreed with it (RAJKI 1962a,[8] 1962c[9]).

3. The starting material of the experiment in 1962, derived from newly received samples of the All-Union Institute of Plant Industry in Leningrad (RAJKI 1966b[10]) and from the T

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[2] p. 23. lines 8—10.
[3] p. 123. lines 8—10.
[4] p. 128. 2—8. and p. 133. lines 5—10.
[5] p. 555. lines 18—21.
[6] p. 127. Fig. 1.
[7] p. 138. lines 14—15.
[8] p. 128. 9—12 and p. 129. lines 16—20.
[9] p. 66. lines 46—57.
[10] p. 555. lines 9—12.

mirjazev Academy in Moscow (**Rajki** 1967[11]). In both places the heads were isolated *once*. In this form the experiment started with *once-isolated* seeds. The selection pressure remained and the result agreed with the earlier.

4. *The author did not examine the frequency of the spontaneous mutations in the spring habit* when he counted frequency of the supposed conversions (**Rajki** 1960[12]). After the first winter he considered only the number of the surviving plants. If he had taken into consideration the whole potential population, namely the plants perished and their supposed offsprings too, the result would be quite different and the variation frequency would have remained within the probability of spontaneous mutations.

5. We understand from S. **Rajki**'s papers (**Rajki** 1962a[13], 1962b[14], 1962c[15]) that not only the spring habit but numerous other morphological characters altered, too. Most of these properties are not in correlation with the winterhardiness or winter habit, which means that *the change of spring character was only one, among many others.*

6. We can read in other reports (**Rajki** 1960,[16] 1962a[17]) given by the author, that he began his experiment not only with the variety "Lutescens 62", but with many others. The "Marquis" wheat resisted obstinately all treatments (**Rajki** 1962b[18]). It seems that the transformation failed in all Italian wheat varieties too (**Rajki** 1962a[19]) because no mention is made of these varieties in the later papers.

Let us reveal some data on the "Lutescens 62" spring wheat. The variety was selected from a local population grown in the Poltava region. In this region both winter and spring wheats have always been grown. Therefore it is sure that the old local variety was extremly variable. Between 1935 and 1945 the variety was maintained with the pedigree method but it is well known that later, from 1945 to 1955, the pedigree breeding was disregarded by Lysenko in the Soviet Union, supposing a disadvantageous influence on the ecological adaptability of the varieties improved by this method. The author confesses, too, that the starting material needed selection (**Rajki** 1962a,[20] 1962c[21]) in the course of the experiment. This proves the truth of the previous supposition.

According to **Nosatovskij** (1951[22]) the variety "Lutescens" 62 belongs to spring wheats with maximum frost resistance. In the Northern Caucasus it can bear the temperature of 9.5 °C below 0 without any damage.

Finally an important establishment of A.P. Gorin (citation by **Rajki** E.—**Rajki** S. 1966[23]). *The spring wheat Lutescens 62 is in 80.2—95.3 per cent an open-flowering variety. This statement should have been taken into consideration when choosing the starting material.*

The discussed data collected from the author's papers prove that **Rajki** disregarded several fundamental requirements of scientific evidence. No doubt that after three-year selection pressure there appeared several strains with markedly changed properties. Some of these lines were really autumn ones as proved by R. **Riley** (written report only) *but this change*

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[11] p. 23. lines 13—20.
[12] p. 123. Table 5. and p. 124. lines 9—13
[13] p. 138. 17—20. and p. 141. lines 28—32.
[14] p. 242.
[15] p. 87. lines 17—31.
[16] p. 121.
[17] p. 126—127.
[18] p. 234. lines 49—50.
[19] p. 127. 12—16. and p. 138. lines 6—8.
[20] p. 127. lines 42—45.
[21] p. 66. 24—28. and lines 39—41.
[22] p. 334. lines 28—29.
[23] p. 7. lines 16—17.

can be explained in terms of information genetics concept, because the author left out several conditions and reasons which could limit the possibility of such an explanation.

In my opinion the experiment is not conclusive, the composed hypothetical model is not yet proved and the "training" as a general improving method is not acceptable.

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DIFFERENCE IN OPINIONS CONCERNING AUTUMNIZATION

Author's comments on J. Lelley's "Commentary on the book 'Autumnization and its Genetic Interpretation' ".

After having been successfully presented as an Academic Doctor's dissertation at the Hungarian Academy of Sciences in November 1966 my book "Autumnization and its Genetic Interpretation" was published in English in July 1967.

During the past year and a half, since the publication of the book, numerous reviews have appeared discussing the merits of the book (Berichte über die gesamte Biologie 285 409, 1968; Biological Abstracts 49 976, 1968; Euphytica 17 127, 1968; Heredity 23 312, 1968; Landwirtschaftliches Zentralblatt, Pflanzliche Produktion 13 1139—1140, 1968; Nature 217 291—292, 1968; Plant Breeding Abstracts 38 199—200, 1968; Selskoye Hozyaistvo za Rubezhom (3) 29, 1968; Z. Acker- und Pflanzenbau 127 174—175, 1968). Of course, some obviously erroneous statements in the reviews, e.g. "One sowing in spring of the form supposedly converted to winter habit is said to be sufficient to cause reversion to spring habit (page 32)" (Nature 217 291—292, 1968) would need correction, however, the latter certainly did not fall within the author's competence. Even so, I thought it proper that a commentary on this book be answered by the author.

Versus our autumnization experiments two objections of primary importance were raised in Lelley's Commentary published in this issue of the Acta Agronomica Academiae Scientiarum Hungaricae:

1. The homozygosity of spring growth habit of the initial stock is said not to have been proved beyond doubt.

2. In contrast with the author's interpretation an explanation of autumnization based on spontaneous mutation is thought to be possible.

Let us first consider objection No. 1.

The third autumnization cycle has been deliberately chosen to be discussed in the first place, bacause here we could wholly consider the experiences of earlier autumnization experiments, including the shortcomings, and the theoretical and methodical objections raised by the reviewers. The methodology based on sowing times may be characterized — among others — by the following: (a) strict pedigree selection on a single plant basis, (b) sowing such seeds which originate from spikes flowering under an isolator, (c) the individual examination of each plant and plant progeny in winter and spring sowings, when a portion of grains of each plant is sown in autumn for autumnization, while the other portion is sown in spring for progeny test, i.e. a continuous control of growth habit of the initial stock and that of the conversion of spring growth habit into winter one by progeny test, and (d) by other genetic analyses and by analysis of phasic development and other physiological and biochemical characters.

Thus, in contrast with Lelley's statement the growth habit of the initial and experimental stock and its conversion was continuously under checking by progeny test from the very beginning of the autumnization experiments. The progeny tests in all the three experimental cycles were supplemented several times by other genetic analyses and by analysis of phasic development and other physiological and biochemical characters. On the basis of the exactly identical results of all these analyses was the initial stock taken as pure spring wheat and the forms coming from conversion, as alternate, semi-winter or, respectively, winter wheats.

Since the spring of 1966, when the manuscript of the book was completed, the homozygosity of spring growth habit of the "allohexaploid" Lutescens 62 lines, the main initial stock of our autumnization experiments, has been proved, in conformity with the aforementioned control analyses, by monosomic analyses carried out first in the Plant Breeding Institute, Cambridge, and partly in parallel with it also at Martonvásár (RAJKI—RAJKI 1969).

Even in the third autumnization cycle more than 7—8 generations of the initial stock "isolated and undoubtedly self-fertilized, selected and controlled" continuously by progeny test and several times in each cycle by other analyses mentioned, were grown if the winter generations, raised partly in green-houses, are also taken into account. Thus, if at the beginning of the experiments the initial stock had not been a wheat of homozygous spring growth habit, then over the years the forms differing from the spring growth habit would certainly have been found among the tens of thousands of initial (control) plants of spring sowing.

In the first and second cycles of the autumnization genetic experiments — as compared with the third cycle — the experimental methodology varied mainly in so far as we did not isolate each spike whose grains were sown afterwards. However, this specificity of experimental methodology has been indicated in the book (page 22), thus Lelley's references to our earlier publications were scarcely needing.

On the other hand, in some questions put forth by Lelley partly in an incorrect way, being satisfied with referring to previous papers the details were omitted intentionally in the book.

The open-flowering rate of Lutescens 62 established by **Gorin** (1953) and referred to by Lelley, corresponds to the open-flowering values of other wheat varieties studied in the Martonvásár wheat flowering biology experiments (**Rajki** 1960). However, in the first autumnization cycle carried out yet without spike isolation, the proportion of spontaneous hybrids was much less than 0.19 per cent which had been a spontaneous hybrid rate as published by **Gorin** (1955, 1961). This is readily understandable when we consider that Gorin's data came from sowings specially designed for studying spontaneous hybridization where — in contrast with our autumnization experiments — the mother plants were sown around with the pollinating plants. Otherwise, according to a previous paper on the subject (**Rajki** 1962) for first six years of autumnization experiments altogether 123 900 plants were studied and only "... a few plants were removed because of mechanical mixing. According to data of progeny tests a little more of plants proved to be spontaneous hybrids. These plants and their progenies have been considered and studied as hybrids."

However, it is to be noted that the outcome of the first autumnization cycle carried out without spike isolation, i.e. the conversion of spring wheat into winter wheat under the influence of a changed environment, is considered to be undisputable only in the possession of the identical result of the third autumnization cycle which was carried out with spike isolation.

Lelley's following statement also calls for correction: "... the change of spring character was only one, among many others." As Lelley writes: "We understand from S. Rajki's papers (**Rajki** 1962a[13], 1962b[14], 1962c[15]) that not only the spring habit but numerous other morphological characters altered, too. Most of these properties are not in correlation with the winter hardiness or winter habit ...".

In contrast with the just cited statements, autumnization was accompanied by not "numerous" but, all in all, only by two such morphological changes which were "not in correlation with the winterhardiness or winter habit." As to our present knowledge, the first of these two, a spike with branching rachis might range among "random" variations. The other, the gradually developing awnedness of the awnless Lutescens 62. The latter as a phenomenon, i.e. the appearance and gradual development of awnedness of an awnless wheat when grown without renewing seeds for several years under the soil and climatic conditions of the Great Hungarian Plain, is a common knowledge to the Hungarian wheat specialists. Otherwise, it should be noted that one of Lelley's references (**Rajki** 1962a[13]) is not related to this subject at all, therefore, it is incorrect.

Lelley's following reference to **Nosatovsky** (1951[22]) is also incorrect: "... the variety 'Lutescens 62' belongs to spring wheats with maximum frost resistance. In the Northern Caucasus it can bear the temperature of 9.5 °C below 0 without any damage." **Nosatovsky**'s (1950) referred statement actually sounds as follows: "In the Northern Caucasus the variety Lutescens 62 proved to be more frost-resistant as having survived in good condition a temperature of 9.5 °C below 0 at the time when the variety Melanopus 69 was slightly damaged at the same temperature." Thus, in the Northern Caucasus the *aestivum* spring wheat Lutescens 62 proved to be slightly more frost-resistant as compared with the *durum* spring wheat Melanopus 69. A slightly more frost-resistant Lutescens 62 as compared to a *durum* spring wheat well-known of its slight frost resistance — every wheat specialist knows what this means. On the winter and frost resistance of our Lutescens 62 lines as related to that of winter wheats concrete information obtained under Hungarian conditions can be found by anyone in Tables 6 and 10 of the book "Autumnization and its Genetic Interpretation".

In the last paragraph of page 22 of the book in question the following may be read: "Autumnization experiments were carried out on several varieties of spring wheat (**Rajki** 1960, 1962a, 1962b, 1963, 1965a, 1965b, 1966). The Soviet spring wheat variety L 62 was the most thoroughly and diversely studied in our experiments." Under our conditions the variety Marquis which has resisted autumnization, is an alternate wheat and, due to its growth habit, digressing from spring wheats, its autumnization most probably needs a special treatment. However, to study the process of autumnization most thoroughly and diversely our efforts were mainly concentrated on one variety, Lutescens 62. Thus, there was no possibility to elaborate a special methodology for autumnizing the alternate wheat Marquis which has resisted the procedure efficient for autumnizing Lutescens 62 and other spring wheat varieties.

In the first part of another reference to further initial stock for autumnization (Rajki 1962,[19] page 127, lines 12—16) the following may be read "Beginning from 1957 also Italian varieties (San Pastore, Produttore, Autonomia, Fortunato, and others), non-hardy non-winter or not sufficiently hardy and winter ones under our conditions, were included in tests in order to obtain, first of all, basic material for wheat breeding." Thus, Italian wheat varieties were used not for autumnization genetic experimentation but in order to obtain basic material for breeding. And this is the reason why there is no information on these varieties in our autumnization genetic publications. It should be noted again that the second part of Lelley's reference mentioned (Rajki 1962a,[19] page 138, lines 6—8) is also unrelated to this subject, therefore incorrect.

Lelley's objection No. 2, which raises the question of explaning autumnization in terms of spontaneous mutation, may be answered in short.

"The reigning modern view is that, in nature, the direction of mutational change is entirely at random . . . " — writes Waddington (1953), but other authors of modern textbook of genetics might also be referred to.

"Autumnization, the adequate gradual transformation in the genetically pure spring initial stock in accordance to the quantity and quality of autumn cropping cannot be acceptably explained through a gene concept denying the inheritance of acquired properties. Thus, the category of mutation is not applicable to autumnization." — written in the book (Rajki 1967).

Thus, the category of mutation is not applicable to autumnization as a non-random, but as an adequate conversion corresponding to the inducing circumstances. Notwithstanding, with great interest would I study a precisely expressed explanation for autumnization as adequate genetic conversion, based on the concept of information genetics and thought to be correct by Lelley.

Though, on the frequency of autumnization as an adequate genetic conversion the following may be read: ". . . for one pure line certain sowing time variations may be adequate to convert from spring into winter wheat, while for others they are not 'adequate'. For this reason, bearing in mind Glinyany's (1963) statements on the different phasic developmental quality of the shoots of plants, it is correct when considering the frequency of conversion of spring to winter wheat to distinguish first between pure lines and their sub-lines and secondly between sowing time variations. In the first cycle the frequency of conversion determined as just described was favourable because in the sowing time variations which were adequate for autumnization caused the majority of the L 62 lines and sub-lines to convert from spring into winter wheat (Rajki 1962a). The situation was similar in the third cycle, although, there we could measure only the effects of two autumn croppings. The frequency of conversion in the second cycle was lower. This was because sowing only took place on one autumn date after the first year of experimentation. This circumstance reduced the number of sowing time variations and consequently the number of variations 'adequate' for conversion from spring into winter wheat." — (Rajki 1967).

Consequently, frequency of conversion is determined by the methodology applied.

Finally, Lelley's following statement may hardly be taken as scientifically correct: "Assumption of the inheritance of acquired properties . . . when experimental biology proved the existence of pure lines . . . fell." In this respect I feel that it is sufficient to refer to recent developments of the discussion on Crick's central dogma (Commoner 1968), the modernized version of Weismann's germ plasm theory which (the latter) had emerged as an alternative to the theory of inheritance of acquired characters.

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CHRONICA

LÁSZLÓ CHOLNOKY

1899—1967

László Cholnoky, corresponding member of the Hungarian Academy of Sciences, Kossuth-Prize winner, Head of the Department of Chemistry at the University of Medicine in Pécs died on 12th of June, 1967. His unexpected death caused an irreparable loss to the scientific life and higher education in Hungary and to the international chemical and phytochemical research.

László Cholnoky was born on 29th of May, 1899 at Ozora in Tolna county. After having completed the grammar school at Veszprém he could not temporarily matriculate at the university as he was enlisted for one-and-a-half year during World War I. Following his discharge he immatriculated at the Pázmány Péter University in Budapest and in 1922 became a dispensing chemist. His particular interest in chemistry grew apparent during his years at the university when he became student of Lajos Winkler, world-known professor of analytical chemistry. Under Professor Winkler's direction he prepared his dissertation "Determination of iodine content in organic compounds" by which he obtained a degree on pharmaceutics in 1924. The time he spent with Winkler later proved very useful, as regards primarily his working methods. He made good use of his knowledge of analytics.

In September, 1924, he joined the staff of the Chemical Institute at the Department of Medicine of the University of Pécs as an assistant lecturer. In 1929 he became first assistant and in that very year he obtained his Ph.D. degree as well. His scientific activity began during his apprenticeship to Professor Zeichmeister which was followed by his becoming a close associate to him. In appreciation of his achievements he was qualified as a honorary lecturer on biochemistry of natural organic compounds. In 1943 he succeeded Prof. Zeichmeister which was followed in 1946 by his appointment to associate professorship. As its head he took over the Department of Chemistry at the University of Medicine in Pécs in 1948. The National Postgraduate Degree Granting Board declared him a Doctor of Sciences in chemistry in 1952. Seven years later, in 1959 he was avarded the IInd degree of Kossuth Prize. The next year, in 1960 he was elected a corresponding member of the Hungarian Academy of Sciences and in 1966 he won the highest degree of the Order of Labour.

Between 1957 and 1961 he acted as sub-rector of the University of Medicine in Pécs, which was followed by a four-year term of rectorship there. Besides these posts he acted as the local president of the Association for Informing on Science for four years and also filled the presidency of the local branch of the Association of Hungarian Chemists.

László Cholnoky's research work was confined almost exclusively to studying the carotinoids. As an apprentice to László Zechmeister he prepared his second paper on the carotine of paprika in 1926, which he published in association with his master. Zechmeister and Cholnoky renewed and transformed for practical research Cvet's forgotten chromatographic method for the separation of the yellow and red liposoluble carotinoid plant pigments containing simple and double bonds alternately and relating in structure to each other. Cholnoky's first independent pioneer study in this field was published in 1933 under the title "Fractional adsorption applied in separating natural organic compounds". Their joint conclusions were published in the monograph "Die Chromatographische Adsorptionsmethode" (1937—38. J. Springer Verlag, Wien). This work was published in English by Chapman and Hall, London, in 1943. ("Principles and Practice of Chromatography"). Not only in the carotinoid research was this paper a pioneer work, but all over the world it introduced the indispensable method of chromatographic separation.

In his research of the carotinoids a further progress was provided by his study-tours prior to World War II. In the Zeiss-Works in Jena he studied theoretical and practical aspects of the optical instruments, while in Graz he mastered with professor Pregl the methods of organic microanalysis setting out to develope at that time.

In the meantime he reported in association with László Zechmeister on the isolation and separation of pigments of *Capsicum annuum*, *Calendula officinalis*, *Physalis alkekengi*, etc. (in 16 successive papers in the series "Untersuchungen über die Carotinoid Farbstoffe" published by the periodical "Justus Liebigs Annalen der Chemie"). They found several carotinoids unkown up to their time; i.e. capsantine, capsorubine, lycoxantine and lycophyll. During the last years of his life László Cholnoky isolated α-cryptoxantine, cryptocapsine and foliaxantine from various plants and elucidated the anomalous structure of foliaxantine containing allen-bonds through international co-operation in the application of mass-spectrometric method

Cholnoky's interest was later more and more directed to the biogenesis and plant physiological role of the carotinoids, that was how he became one of the very first plant biochemists and chemo-taxonomists in Hungary. He attracted world-wide attention when established that the carotinoids, previously regarded as inactive metabolic end products, play an important role in the oxygen supply of the plants.

By extensive studies he pointed out that β-isomer ionin-cyclic carotinoids were transformed into epoxids and lost oxygen readily under proper conditions while producing α-isomer. He found three carotinoid systems transporting oxygen, which operate under different life conditions in plants.

In addition to his research work László Cholnoky taught with great enthusiasm generations of medical students at the University of Pécs. His directives and advices have been utilized in plant breeding by the research institutes of agriculture. Both his memory and achievements are kept alive by the Hungarian and international plant biochemistry and organic chemistry alike.

L. Szabó

Acta Agronomica Academiae Scientiarum Hungaricae, Tomus 18 (3—4), pp. 465—472 (1969)

RECENSIONES

I. TOMBOR: *Magyarországi festett famennyezetek és rokonemlékek a XV—XIX. századból* (Hungarian Painted Wooden Ceilings and Related Relics in the 15—19th Centuries). Akadémiai Kiadó, Budapest, 1968.

After two decades of collecting work the author has made an attempt of giving both ethnographic and historical description of those ornamentally painted wooden ceilings, pulpits, pews and organ lofts which have survived in churches, or to a less extent, in secular buildings. In the book the trace of the creative thought is followed in its historical aspects and this tracing back extends even to Czechoslovakia and Rumania. Painted on soft-wood or fir plank, then attacked by wood-borer the pictures were passed into limbo, where, due to incompetence, they have got lost; this is why the book is so important. In the best case the paintings were deposited and preserved in museums.

Hard work had to be done by the art historian as hardly any written documents were available. The bills, deliveries and expenditures of the craftsmen making wood-painting in castles and churches have not been preserved; perhaps the archive-documents to be proceeded will yield information in this connection.

History of the revealing work goes back to not long ago. In the late seventies of the past century the historians, archeologists and ethnographists took note of some interesting wooden ceilings in different areas of the country. At Gógánfalva in Transylvania a late Gothic ceiling was explored. At this time the art historians were interested in national ornamentation and what they studied was the Western and Oriental influence on Hungarian art. In 1905 the second volume of "The Book of Art Craft" by György Ráth contained László Éber's contribution on the relics of furniture craft in Hungary. Jolán Balogh's comprehensive paper "Art of Late Renaissance and Early Baroque" appeared in Volume III of the Hungarian Cultural History (1940). In 1942 the Gerevich Dedicatory Volume issued Pál Voit's paper entitled as "Contribution to the Bibliography on Hungarian Painting Cabinet-Makers". Finally, in 1961 János Tóth published a paper on "Traditions of the Hungarian Folk Architecture" making mention of the painted wooden works of the rural churches.

Who were the masters and who were the customers? The former: painting cabinet-makers. There were some whose names have remained known, for example that of Mihály* Mennyező of Mezőlak. He was commissioned by Antal, abbot of Kapornak to paint the ceiling of the local church (Kapornak housed a Benedictine abbey established in the county Vas—Zala in the 12th century. Its church was founded in 1450. The abbey itself perished in the stormy past). Name of the emblazoner and cabinet-maker of the Prince of Transylvania Gábor Bethlen (1613—29) is also known: János Egerházi Mezőbándi. The masters were ordinary craftsmen and the rural congrega-

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* Firmament-maker

tions put them in charge of wood-painting. After Battle of Mohács in 1526 the country was divided into three parts: Transylvania separated, the central part got under Turkish rule, while the Western area was dominated by the Hapsburg monarchy. Throughout the Turkish occupation, up to the end of the 17th century the nation permanently faced extermination, the towns and churches were perished. When being reconstructed the former medieval churches were not rearched, the rural congregations with artistic taste erected wooden ceilings, then had them painted. In the Calvinist churches neither altar-piece, nor statuary were found; "... Christ embodied, but not for being a model for an artist ..." was laid down in the Helvetian Confession II *(Confessio Helvetica Posterior)*. In spite of the prohibition of paintings one could encounter flower-decked wooden ceilings in Calvinist churches of the country, just like in the German and Swiss Lutheran churches.

The guild-system came into existence in Hungary too. The first information of organizing into guilds and fraternities can be dated from 1307; this was the year of the issue of the first charter of incorporation. This kind of documents provide interesting information related to our present subject.

Charter of the pictographic guild at Kolozsvár (between 1618 and 1633) wrote: "the joiners and cabinet-makers should paint flowers on wooden boards". The skilled artisans were appreciated, i.e. János Egerházi, aforementioned emblazoner of Prince Gábor Bethlen was raised to the nobility, and this decision was later confirmed by György Rákóczi I. Also is known the name of Gábor Ódór Vasvári, cabinet-maker and church-maker son of a priestly family. At Gyergyószentmiklós the local priest György Ferenczi also made painted wood-works in churches.

How was the adornment made? Mostly free tempera painting was applied on the soft-wood bases of the wooden ceilings, sounding boards, benches and organ-lofts. Beginning with the 16th century their adornments were late-Renaissance, sometimes Baroque or Rococo and their style tended towards folk art. Numerous Turkish elements can be found and even Persian, Byzantine and Sicilian weave patterns can be recognized. In the 19th century the floral ornaments disappeared. As far as the basic motives are concerned the rosetta, or rose-element, the 4—5—6—8 petalled flowers were in use throughout the centuries. Ceiling of the Roman catholic church at Toporc is decorated with a Luther-rose. Rosetta is a central element, but not the same as the rose itself.

At many sites the so-called Italian garlands can be recognized which mean laurel wreath, i.e. symbol of grace of the eternal life. In his "Flowers in Hungary" (Budapest, 1932) Rajmund Rapaics states that laurel became known in this country only in the 17th century. However, a stylized Italian garland was painted on the ceiling of the Gogánváralja church (around 1550) and its form was the same as the one appearing in Transylvania 200—300 years later. The garland motive appeared also in the Kalotaszeg area and the ones in Slovakia are the same as those of the church ceilings of Szentsimon and Nádújfalus painted in 1650 and 1746 respectively. At other sites these garlands are of no-style, hence they are rather of a tulipe-wreath form than a laurel one.

In the same manner a renaissance tradition is displayed by the simple four-petalled flower not resembling rose. Three-petalled flowers also occur, i.e. palmette, lily, or tulip being quite similar to the heraldic lily. The tulip element proved to be inexhaustible. József Huszka presumed in 1883 that Hungarian ornament was of Asian origin. In his book "Origin of the Hungarian Tulip Ornament" (1929) Ernő Balogh regarded it as of Turanian origin. In view of this presumption the tulip motive was borrowed from the Turks by the Hungarians and it was only then that the motive got to the West. It is a commonplace in botany that the tulip is of Asia Minor origin. It was in the 17th century that tulip got to Europe. The author states that tulip only occurred in the Bulgarian decorative art. According to Rajmund Rapaics a part of the tulipe motive is the

Baroque "fougère stylisée", though it is not fern, but acanthus.

Influenced by the aforementioned authors (Ernő Balogh, Jolán Balogh) Ilona Tombor distinguished the rare, naturalistic Western tulip of Augsburg origin from both the elongated lyre-shaped Oriental tulip with a drawn grain in the centre and the specifically Hungarian 3-petalled tulip of Italian origin, deriving from acanthus leaf. Jolán Balogh regards the acanthus flower having not three petals as non-classifiable to among the tulip varieties. According to her this abstract, sprout-like composition is the influence of the acanthus ornamentation of Northern Italy.

Pink also occurred frequently. It is a flower of Turkish origin. Its motive can be found in the so-called "embroidery of rank and fashion" which is nothing else but the influence of the taste of the upper classes on that of the folk art. So pink got onto the church ceilings as a decorative element through the media of the "embroidery of rank and fashion". Stylization coincides with the forms of the Turkish ornamentation — states the author citing Katharina and Otto Dorn's "Türkische Keramik" (Ankara, 1957).

Also Renaissance motive is the pomegranate *(Punica granatum)*. In the author's opinion it is not a Hungarian plant, it became known through imported craft-works primarily textiles (page 24). In the posthumous work of the Calvinist theologian István Szegedi Kis *(Theologiae syncerae Loci Communes)* some interesting data have been preserved. After its author's death this book was published five times in foreign countries. (1585, 1588, 1593, 1599, 1608). Through a biography of Szegedi Kis written by his apprentice Máté Skaricza it has been learnt that he was once put to the torture by a Turkish bey named Peruiz. Some years later Peruiz got to Ráckeve, Szegedi's new settlement where Szegedi awaited him with the intention to forgive. Skaricza described the meeting as follows: " . . . Szegedi ordered me to acquire an elegant aigrette and some pomegranates . . ." *(iubet me Szegedinus elegantem cristam malaque Punica comparare)*. It implies that pomegranate was available at Ráckeve in 1566.

Sunflower or daisy also occurred among the flowers. From the point of view of the history of art it is interesting that well-known Hungarian flowers, such as poppy, violet, pansy and valley lily were not involved in the painted ceilings. It follows from this that the master ignored the occurring plants when working, and this is reflected in frequency of the Southern and West European, Turkish, or ancient Eurasian decorative elements. This is the reason why can be made no mention of Hungarian, or Hungarian-like flowers. " . . . What we have is of Hungarian character, but there exists no motive of Hungarian origin . . ." states the author. Each motive is an adoptation and even the pattern is not original either.

Anybody can observe an interesting parallelism which justifies the author's statement. The Calvinist church at Gyügye has a ceiling with a painted anchor the central part of which is surronded by two flying birds. This table was painted in 1767. In E. L. Sukenik's book "The Ancient Synagogue of Beth Alpha" (1932) Table 8 presents a torah with two birds on both sides; this, however, is a similarity only.

In addition to the floral ornamentation fruit elements can also be found. The grape is the symbol of Christ's blood. The apple-tree reminds of the Paradise of Creation. Oak-acorn motive can also be found which is known from the Gothic style. There is a huge, round-shaped fruit, perhaps a pomegranate, among the decorative elements of the Calvinist church at Villonya, built in 1720. Now this material belongs to the Museum of Ethnography.

Both the leafy twig and leaf are important elements of the painted ceilings. In the Middle Age the Gothic leaf with palmetta ending, twisting onto a stick, or slipping through another gained acceptance, then it occurred less frequently. The garland leaves are of various sizes and smooth with toothed edges. The sharply jagged leaves derive from the Greek acanthus by Turkish conveyance.

Leaves curling in the end, or with heart shape can also be found, then in the 18th century the leaf elements are loosened by helices and tendrils.

The composition can be characterized by the proportionate floral stem, or bunch, sometimes in a vase. The bunch composition proceeded from the East towards the West, just like the Osmanic-Turkish elements appeared in the Hungarian embroidery. The name of "Italian jug" refers to the origin of the elements. Heart or tulip motives can be frequently found instead of plano-decorated vase. The structural form so much preferred by the Turkish and Western textiles, i.e. asymmetrical bending of the floral stem fills up the space. The geometrical patterns reflect the effect of Oriental textiles and carpets, while the potted lines and the linear S form are frequent motives of the Balkan embroidery.

Figuration, i.e. heraldic twin birds, chevaliers, deer, dragon-killing knights, bear-hunting, etc. can also be encountered. Besides the evangelists symbols and biblical scenes are shown by the paintings made between 1503 and 1520 at the church of Gógánváralja. In the 17th and 18th centuries there were no comprehensive series of paintings.

It is noteworthy that rather few Roman catholic churches have preserved painted ceilings from the 17—18th centuries, mostly Protestant churches are mentioned by the author. This is why the ancient Christian symbols prevail, such as the triangle denoting Trinity, agnus Dei, the human-faced sun and moon, the phoenix, symbol of immortality, the pelican, etc. The twin bird is an ancient Oriental motive, imitation of the Byzantian Emperor's blazon. In the 17—18th centuries after Hungary's liberation from the Turkish rule it symbolized involuntary loyalty to the Hapsburgs.

The animal motives of the ceiling pictures, sounding boards and organ-lofts are of ancient Christian origin. A deer is the symbol of 42nd Psalm " . . . as deer desires for water so the soul desires for God . . . ". Decoration of the sounding board shows a pelican feeding its offsprings. There occur motives in relation to seven dragon heads. Cock, or pig-headed animals and lion representing Christ and anti-Christ also appear in a heraldic stylization. Interesting is the picture of the guarding crane. The bird holds a stone between its feet; when it falls asleep the stone is dropped, so it is the symbol of vigilance for the believer. The delphine and whale are the symbols of prophet Jonah. To represent temptation angel, cherub, syrene also appear in the Romanesque art. There are figures which represent Adam and Eva, the snake and Noah's Ark with the animals.

Puritanism of the Calvinist churches is reflected by the fact that no Christ portrayal was found, at the very most some events of the Old Testament were presented in the ictures.

Finally, something about symbolism of the colours. Most preferred were the white, or yellowish basic colours. As in the Saint Tent of the Old Testament the sky is blue on these ceiling pictures too. Yellow or green bases are less frequent. The glary gay-colours are usually avoided, warm brownish red and yellow tonalities are most frequently used.

During the passing centuries a specific art flourished in ordinary rural churches. Perhaps this has avoided the attention of many. Ilona Tombor's work reveals for us the hidden beauty in which one can recognize what is eternally human, and she demonstrates that human being has been seeking beauty. This is what has been brought to light; thank is due to her.

Another work by Ilona Tombor: Old Hungarian Painted Woodwork in the XV—XIX Centuries. (English). Corvina, Budapest, 1967, pp. 53, 48 Tables.

F. PAP

E. KEMENESY, G. A. MANNINGER: *Die Luzerneanbau und Pflanzenschutz* (Lucerne growing and plant protection). Akadémiai Kiadó, Budapest, 1968.

Authors wish to call the attention of trained practical experts primarily to those modern basic principles of cultural practices and control methods by the use of which lucerne can be made one of the most important crops of large-scale farms. Authors pointedly endeavoured to avoid generalization and commonplace discussion of the problems. While the book was originally written for Hungarian practical agronomists, by differentiated treatment of the material it may certainly count on interest and can also be utilized abroad.

In the first part, in 18 chapters on 147 pages E. Kemenesy discusses up-to-date cultural practices of lucerne growing, with simultaneous evidence given of its favourable economic effect on the whole of the farm. In fact, by this method of discussion author points to a highly important but insufficiently utilized possibility of rising the agricultural production. Theoretical statements are in every chapter represented by excellent practical examples.

The first chapter discusses briefly the Hungarian varieties and the origin and distribution of lucerne. Chapter 2 summarizes the basic biological principles of lucerne which should be known to practical agronomists. Within the frames of the soil and climatic conditions of lucerne growing Chapter 3 deals with the practical classification of lucerne soils as well as those methods which render successful production possible in less suitable soils too. Chapters 4 and 5 discuss application of fertilizers and liming of lucerne, while Chapters 6 and 7 deal with suitable cultural practices for preparing the land and methods of seeding respectively. Chapter 8 gives brief information on inoculation treatment of seed with *Rhizobium* cultures, while Chapters 9 and 10 make us acquainted with control of weeds and dodder respectively. Chapter 11 deals with the mechanical cultivation of lucerne fields.

The important question of the right date and frequency of cutting is treated in detail by Chapter 12, with an appropriate view of lucerne biology. Chapter 13 deals with the agrotechnical conditions of economic irrigation, with the technique and effect of irrigation. Chapter 14 discusses in detail the questions of cropping history of a lucerne field and rotation respectively. It is also in this chapter that the right proportion of lucerne grown in the farm and the length of the reasonable period of its utilization are discussed. Chapter 15 gives detailed information on the harvesting and storage management of feed stuff, while Chapter 16 surveys the role taken by lucerne in rational feeding of livestock. Chapter 17 discusses the effect of lucerne growing on the whole farm from an economic point of view by supplying plentiful practical examples.

Finally, Chapter 18 gives a detailed survey on lucerne seed production, from the choice of variety, through a discussion of the conditions of successful special seed production and occasional seed production carried out as a subsidiary farm enterprise — up to the problems of pollination, fertilization and harvesting.

The short summaries at the end of each chapter provide a good structure.

In the second part of the book G. A. Manninger discusses the plant protection of lucerne in five chapters on 78 pages. This part deals with the plant protection problems of lucerne in view of an integrated plant protection applying manifold and harmonic methods. The great number of lucerne pests and diseases are classified in a taxonomic key on the basis of damages caused, then biology, prediction and control techniques of dangerous pests and diseases are treated in detail. In directing the control work considerable stress is laid on the prediction, further on the possible protection of useful and indifferent organisms.

Chapter 1 touches briefly on the plant protection problems of lucerne in large-scale farms. Chapter 2 gives a taxonomic key on the basis of damages caused, then refers shortly to the control. Chapter 3 discusses in detail the biology of dangerous root-, leaf- and seed pests and diseases. The information on the biology of the individual pests is completed by the presentation of the methods and possibilities of prediction. This chapter deals with reliable farm prediction and signalization as the basis of prevention.

Chapter 4 discusses in detail the efficient methods, time and technical realization of pest control. Finally, Chapter 5 includes the planning of control work, organization and supervision of the individual operations as well as the assessment of economic concerns. Similarly to the first part of the book each chapter is completed by useful summaries. After a list including 110 references the index was separately completed in accordance with two parts of the book.

Z. Bőjtös

Á. Hegedűs, P. Kozma, M. Németh: *A szőlő. Vitis vinifera* L. (The Vine. *Vitis vinifera* L.). Akadémiai Kiadó, Budapest, 1966.

The Agronomics Dept. of the Hung. Acad. of Sci. in 1955 started the series: "Cultivated Plant Life in Hungary" ("The culture flora of Hungary") with 5 fasciculi discussing 6 plants. After having issued the provisional fascicules being considered an experiment rather, the work started, in its final form, in 1959. The first 14 fascicules contain the cryptogamic plants and the coloured atlas, while from the 15th on, the floriferous plants are being discussed.

The work on vine containing 325 pages, was published in 1966.

This one, too, endeavours to meet the requirements of the series; the working up of the subject has been accomplished with the collective work of many an author giving a true picture both theoretically and practically of all that knowledge the readers of the series might need.

As an introduction we find the taxonomic characterization of the family *Vitaceae* written by Soó. The name of vine is explained by Priszter referring separately to the plant, the grape, the vine-lands and the wine. This is followed by the taxonomic treatment of vine. The genus and the main species of *Vitis* are characterized by Hegedűs, while Terpó it as given — on the basis of his original researches — the taxonomic key of the wild-growing and naturalized vine species of Hungary.

The history of growing vine is elaborated by Hegedűs while its historicultural references are submitted by Priszter. The cytological circumstances, the highly detailed outer morphology and mainly, the anatomy based on original and new researches, are described by Hegedűs. The latter has written the propagation-physiology and growth-physiology chapter, too, while the author of the chapter dealing with metabolism-physiology and with the chemical composition, is Eifert who has even promoted the knowledge of the problem with his scientific research work.

The flower-biology of vine has been elaborated by Kozma who is a researcher of the problem being acknowledged internationally, too.

This is followed by the chapter: "The Vine and its Environment" in which soil factors are described by Witkowsky; the climatic, physiographic as well as biotic and agrotechnical factors are dealt with by Csepregi, expert in this field; the problem on agrotechnical effects in viticulture has been elaborated by Szűts.

On the injurious factors of vine the pathogens and biologic diseases are described by Barra, weeds are discussed by Vida while parasites are made known by Bognár.

The author of the next chapter dealing with the hereditary conditions of vine, is Koleda; the chapter on vine breeding is written by Kozma who is keen to do that work in the frame of his activities as a researcher.

The yield data of vine are submitted by Csepregi, the economic importance and utilization are discussed by Rakcsányi, excellent expert in oenology.

Priszter offers a survey on the main vine varieties; a detailed report on variety stocks and their parental varieties is given by Eifert, and that on table-grape varieties by Darnay; wine-grape varieties are described by Németh.

The last chapter discusses the varietal taxonomy of vine. Hegedűs makes us acquainted with the important variety systems known so far; Terpó submits the phylogenetic system of vine according to modern nomenclature being based on the above statements and on his own researches. Finally follows the taxonomic key of the respective vine varieties written by NÉMETH. The work is completed with ample literary references.

The work is supplemented with very rich material of Figures the majority of which — equally to that of the text, — is original.

When glancing over the abundant and manifold material, we have to establish that each collaborator did his best and thus the work might be ranged among the best pieces of the series giving entire satisfaction to those interested or showing the way to further work on the basis of plentiful literary references.

The 26th fascicule fully achieves the aim of the series, i.e.: to submit an important and modern review on the culture plant in question from both theoretical and practical viewpoints and covering all details. Its importance is evident since in this work the most significant culture plant of Hungary is concerned.

It is a great pity, however, that so far the whole series has been published in the Hungarian language only. For foreigners that circumstantial and most valuable work as well as the numerous and scientific results are scarcely accessible. Abroad opinion has been already expressed on the above and therefore, it is deemed desirable to have every booklet translated and published in foreign languages. This would surely contribute to the good reputation of Hungarian scientific work in a much wider circle.

Z. E. KÁRPÁTI

S. TERÉNYI, GY. JOSEPOVITS, GY. MATOLCSY: *Növényvédelmi kémia* (Chemistry for plant protection). Akadémiai Kiadó, Budapest, 1967.

Chemicals protecting and promoting resp. health and productivity of plants have increasingly wide applications in agriculture, horticulture, viticulture and forestry. The wide spread of "chemical plant protection" is due to the realization of chemicals being the most rapid and safe means of controlling pests, diseases and weeds. Preventive and protective chemical treatments are the most frequent ways of application, however, curative methods and even various treatments, such as repellent and attractant control as well as the use of antibiotics, phytoncides, bacteriotoxins, microbial insecticides and chemosterilants, etc. become more and more widely accepted.

Owing to the multitude of chemicals even the experts can hardly be kept informed, not to mention those who are more or less infamiliar with chemical plant protection. At present more than thousand active agents have to be known in order to have a view of the most necessary fundamentals. In the last decades not only the number of plant protectives and regulators has increased rapidly but also the quantities of chemicals produced in the world have amounted to several million tons.

Authors' work is thus welcomed as it gives the readers high-level information on the manifold questions of chemical plant protection, on the knowledge and use of its materials. In spite of the fact that every day new chemicals and active agents are employed in practice, authors' book is still a great help to the readers who obtain adequate information on the results of the recent past. Starting from this basis the recent developments can be surveyed easily and acquiring of thorough knowledge requires less care.

Authors' work is of an extent of 462 pages ans is divided into 5 parts. Knowledge of the chemicals is made easier by many structural formulas and guidance is given by a detailed index. Each part is completed by a bibliography providing further information.

Chapters of the first, "general part" deal with the following subjects: importance and aim of plant protection, methods and means of control, economy of chemical control, plant protective active agents, preparation and general effects of plant protectives, factors influencing the general effect of plant protectives, licensing of plant protectives, fields and tasks of plant protecting chemistry.

Part II deals with "fungicides and bactericides". The respective chapters discuss the various caustics (their chemistry, way of action, method of application, etc.), cuprous sprays and dusting chemicals, other inorganic compounds used in plant protection, inorganic sulphureous sprays and dusts, organic intermetallic compounds, dithiocarbamates, tiuram-sulphides, N-trichloro-methylmercapto compunds, imidazole- and guanidine derivatives, aromatic nitrils, chloro-chinons and other non-systemic organic fungicides, systemic fungicides, antibiotics and phytoncides as well as compounds suitable for disinfecting the store-rooms of plants and plant products.

Part III deals with "pest killers": we get acquainted with insecticides, acaricides, nematocides, molluschicides, disinfestants of crops, products and rooms, further with rodenticides.

Part IV deals with "weed killers" in general and with the contact herbicides and systemic (translocating) herbicides in particular.

Part V deals with "other chemicals" such as caterpillar glue, wound healing chemicals, grafting wax, chemicals for frost defence, repellents and attractants, chemosterilants, bases and ingredients, plant growth regulators and — finally — defoliants.

Above enumeration of the outlined subjects of chapters shows that authors paid attention to every detail of the subject matter of chemical plant protection. The book deals not only with chemicals and means of chemical control but also with every related chemical task of plant protection. In the individual chapters active agents are grouped on the basis of their chemical composition, and not only the composition, but an outlined description of their preparation, their chemical and physical properties, way of action, scope of effectiveness are also discussed as well as every important task in relation with their application. Authors' material is based on about a thousand literary sources.

When reading the book we have the impression that the authors made, a very thorough and useful work and succeeded in giving adequate information on the manifold subject matter of "plant protection chemistry".

GY. MÁNDY

INDEX

VARIA

FORUM

CHRONICA

RECENSIONES

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A kiadásért felel az Akadémiai Kiadó igazgatója Műszaki szerkesztő: Farkas Sándor
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